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ORIGINAL ARTICLES.

I.—On *Hyperodapedon Gordoni*.

By Prof. Rudolf Burckhardt, Ph.D., of the University of Basel, Switzerland.

(*Continued from the November Number, p.* 492.)

In the foregoing description I have confined my remarks to the right side of the skull. The observer will not fail to notice from the figures the disparities existing in the two sides. This asymmetry is particularly conspicuous ventrally, the region from which Huxley principally deduced the arguments in support of his more important speculations. The area of dislocation, the centre of which apparently lies in the crater-like opening of the left præsplenial, extends from the left præmaxillary to the pterygoid in the skull, and as far as the splenial on the lower jaw. Its place of greatest intensity has been marked by a + on the figure, where not only the surface of the bones is most damaged, but where the mandible has been so much compressed that a crest has actually been formed below the row of teeth on its outer wall.

The splenial too has been displaced; the pterygoid is broken across; a deep fissure separates the three inner rows from the regularly placed outer rows of teeth on the palate-bone.

This dislocation is partly responsible for the deception it caused in the location of the posterior nares, and for the supposed boundary of the palate-bone and the maxillary. Huxley himself, in his first paper, inaugurates the description of the dentition by stating his inability to find any suture in the roof of the mouth, but he supposed such to exist somewhere in the groove of the hard gum, into which the lower jaw is received when at rest.

In his second paper he lays particular stress on the fact of there being only a single row of teeth tending in a forward direction on either the palatine or the maxillary. Certainly some of the smaller fragments show no suture within the denticulated space, but there is one which runs parallel with and is situated laterally to the outermost row of teeth, which can be traced without cutting a cross section through it.

This leads us to a consideration of the dentition itself. Lydekker was the first to make known the existence of one to two rows of detached teeth on the posterior margin of the oral surface in the lower jaw of the Indian species, next to the palisade-like row of

teeth. Huxley considered that the Indian specimens probably did not differ specifically from the English specimens, but merely exceeded them in point of size.

As the two fragmentary specimens of undoubtedly British origin show exactly the same arrangement in the dentition of the lower jaw, Lydekker's contention as to the specific value of the character of his Indian specimens therefore breaks down.

The study of the lower jaw of *Hyperodapedon minor* is particularly instructive in this respect, as the principal row of mandibular teeth extends backward considerably further than in *H. Gordoni*.

The dentition of the palate-bones has been accurately described by Huxley, except in the case of the anterior portion of the right side, which he states has three rows, of which the middle one is decayed away, being indicated only by the empty sockets of the teeth. The regularity in distribution of the teeth is somewhat indistinct on the left side of the fore-part of the palate-bone, and it appears to me to depart from the normal plan, a circumstance which I am inclined to attribute to the local displacement already mentioned. In size the teeth increase consecutively from the front backwards. Neither from this fact alone, nor from sections made at a right angle to their longitudinal line of distribution, is information available as regards a succession of teeth. But judging from a fragment of *H. minor*, containing the germs of the teeth, which have as yet not cut through the bone, I should infer that this does not point to a real change of the teeth, but that it rather suggests the mode of a successive supply of them from the rear, which would continue during the whole of the animal's lifetime.

Now, therefore, that the purely palatine nature of the dentition has been proved, there is no further occasion for assuming a change of teeth to apply to it in the same manner as that in which it is accomplished in the maxillaries. Whether or not such a change of teeth, in its actual sense, takes place in other palatal bones, is a matter for further examination. Whatever its outcome, it is not likely to furnish direct counter-evidence against *Hyperodapedon*, the apparatus for prehension in which is so markedly different.

The peculiar anatomical structure of this apparatus implies a number of physiological derivations capable of throwing light into the vast abyss which divides its dental arrangement from that of *Sphenodon*. It would be wrong to imagine the cutting edge of the lower jaw to move backward and forward in the masticating furrows opposing it. This would be an utter impossibility on account of the two furrows converging towards the front. It is more likely that during the process of attrition, they moved obliquely across the upper part of the apparatus, and that the furrows received the lower jaws when at rest, for which purpose they seem to be provided. This is probably the reason too why the tooth-rows which flank them are ground down. In further support of this view of a gradual expansion of the attritive surface in the posterior portion of the lower jaw, is the fact that it was achieved by an increase of the tooth-rows. Another reason why this expansion has

been confined to this particular place is, that the mandibular teeth are in correlation with the presence of a true horned beak, which would have been a natural obstacle to any development of teeth. In this way, and further too by the continuous renewal of teeth, another useful means has been contrived for the process of mastication.

By way of compensation, during the individual development the dentulous surface was so modified that no disadvantage would accrue to the animal through the incapacity of the mucous membrane to remove the worn-down acrodont teeth.

To look for a physiological parallel of this peculiar kind of dentition it is necessary to go to the Placodontia. Of these latter, however, the material at my disposal did not permit of a detailed comparison, but it should be mentioned here that in the Placodonts the maxillary appears to me to bear no teeth, and to be divided from the tooth-row by a suture.

Referring specially to the tendency to expansion, within the dentigerous portion of the posterior part of the lower jaw, by the introduction of new elements, I remember a parallel case, having noticed on the vomer-plate of a species of *Pycnodon*, which is in the Museum at Basle, that the otherwise regular quinto-serial arrangement was augmented by an additional tooth in its widest posterior part.

From the character of the teeth in *Hyperodapedon*, the question arises once more as to the natural haunts of the animal. What is the kind of food required in the case of a placodont animal? Generally this consists of Crustacea, Molluscs, Echinoderms, and other hard-shelled animals. If we take into consideration the dentition alone, coupled with the extraordinary position of the eyes, to which may be added the reduction in size of the posterior extremities, one feels inclined to attribute to it a marine existence; more particularly would this be the case if Huxley's supposition as regards the length of its tail were confirmed. On the other hand, the structure of the manus, in which no tendency to a lengthening of the phalanges can be perceived, is in direct contradiction to this interpretation.

Hyperodapedon, therefore, and probably also *Rhynchosaurus*, will have to be regarded as inhabitants of the littoral. What other terrestrial animal is equipped with a similar dental structure? Or what else could have induced *Hyperodapedon* to frequent the sandy Triassic shores, from whose strata up to the present no signs of petrefactions have been procured, except fossil reptiles.[1]

[1] The writer desires to refer to the remarkable discoveries made prior to 1892 in the Elgin Sandstone, Morayshire, which were described by Mr. E. T. Newton, F.R.S. (Proc. Roy. Soc., Dec. 15, 1892, vol. lii, pp. 389–391; Phil. Trans., vol. clxxxiv), in which he enumerates *Gordonia Traquairi*, *G. Huxleyiana*, *G. Duffiana*, *G. Juddiana*, *Geikia Elginensis*, and *Elginia mirabilis*. Reference was also made to a form resembling *Ætosaurus* (Geol. Mag., 1893, p. 557) named *Ornithosuchus Woodwardi*, and to *Erpetosuchus Granti* (see Proc. Roy. Soc., Dec. 7, 1893, vol. liv, pp. 437, 438; Phil. Trans., 1894, vol. clxxxv B, p. 573, pls. liii–lvi). There were probably also two species of *Thecodontosaurus* from the Trias of Bristol, and perhaps a third from Leamington.

I carefully sought for any evidence of dermal ossification, and detected a few vague signs here and there: for instance, on the eighth rib of the left side, and on the opposed surface, in the vicinity of the ends of the eleventh and the twelfth ribs; also, some small plates of an oval shape on the humeri. Under favourable light the contours of the body, too, seemed to be indicated, notably in the interspaces between the ends of the ribs. Finally, as may be seen from our figure of the counterpart of the right side, a heart-like projection can be observed in the blank space near the fourth rib, differentiating it from other parts, through absence of matrix in that place, from which a fibre of the thickness of a finger starts, tending towards the neck in a decided manner, where it disappears again in the slab. I suspect it to have been a visceral organ, probably the stomach, to judge from its position.

It may be mentioned that there are two specimens of *Rhynchosaurus* in the British Museum in which indications of the skin can also be traced. Lortet has also already described such structures in *Sauranodon*. In one of the *Rhynchosauri*, viz. the type from which Huxley figured its hind-foot (pl. xxvii, fig. 5), the skin is so unmistakable that I have reproduced it here.

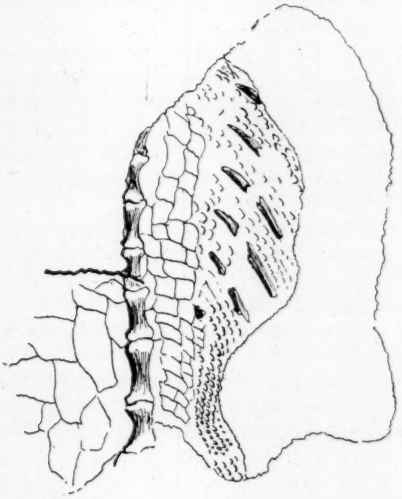

Fig. 3.—Skin from the posterior abdominal region of *Rhynchosaurus articeps*. Two-thirds nat. size. From the specimen preserved in the British Museum (Natural History).

It belongs to the abdominal region, and vividly recalls a fragment from the skin of a Lepidosaurian. But on this head I will not venture upon any evidence of a closer relationship with either the latter or any of the Rhynchocephalians, since we are yet quite ignorant as to the skin structures of the Theromorphæ. A more intimate knowledge of the Lepidosauria from this point of view may even necessitate a change of the name.

The second specimen, disclosing impressions of the skin, is that which supplied Huxley with the type for tab. xxvii, fig. 2. I have been able to detect some smaller scales on this near the remains of the caudal vertebræ, but not so clearly to be seen as in the other example.

I cannot conclude my account of *Hyperodapedon* without making a few remarks on the systematic position of the Rhynchosaurians. Although in the beginning of Huxley's second treatise he strongly supports the theory of an intimate relationship existing between this extinct group and the living *Sphenodon*, his conclusions, however, are that they have only the following characters in common with each other :—

1. A præmaxillary rostrum.
2. A longitudinal series of palatine and maxillary teeth, of which the posterior ones receive between them the mandibular row.
3. An abdominal sternum.
4. Absence of procœlous vertebræ in the præsacral portion.

Of the foregoing characters, number 1 breaks down at once, being based upon a supposed identity of origin in two totally distinct structures ; and the second no less so, as will have been seen in our previous discussion. There remain only the third and the fourth points, upon which it would be futile to base characters for the establishment of a closer relationship between them.

Von Zittel, too, ascribes to the Rhynchosaurians affinities with *Sphenodon*, and places them nearer the latter than to the remaining groups of Rhynchocephalians, as does also Smith Woodward.

Boulenger unites the Proterosauridæ with the Palæohatteridæ to form his Proterosauria. Some of the characters which he assigns to this group are shared also by the Rhynchosaurians, such as the flattened bone composing the pelvis, and especially the opisthocœlous vertebræ of the Proterosauridæ. The Rhynchosaurians and the Champsosaurians are brought under one heading too, with the latter of which, except through convergence of similarities, they have really nothing in common. For the reasons mentioned, then, the classification as proposed cannot be said to be wholly satisfactory.

Recently Fürbringer brought to a conclusion his comprehensive systematic treatise on Reptiles, wherein, following Baur, he separates *Hyperodapedon* from *Rhynchosaurus*, and places the family Hyperodapedontidæ near that of Proterosauria, and the Rhynchosauridæ with the Rhynchocephalia *vera*. I can only follow the views of these authors in so far as they are restricted to the closer relationship existing between *Hyperodapedon* and the Proterosauridæ, and on account of its being already connected with the latter by the possession of opisthocœlous vertebræ. Otherwise I consider a separation of *Hyperodapedon* from *Rhynchosaurus* entirely erroneous, and I can find no apology for it on the part of these authors, except in the insufficiency of the published materials on which they based their conclusions.

After what has been stated as to the dentition and the characters of the skull of *Hyperodapedon*, there exists no further ground for

trying to effect a closer union of the Rhynchosaurians with Rhynchocephalia vera. We ought rather to regard the former family as a branch, in a wider sense, of the Rhynchocephalian stem, totally independent of the true Rhynchocephalians, and linked in all probability in a more direct manner to the lowest organized Proterosauridæ. So long, therefore, as the inferior zygomatic arch is held to be a differentiating character for the Rhynchocephalians, the Rhynchosaurians will have to be attached to them and not to the Theromorpha. At the same time it should be borne in mind that latterly Baur and Case have excluded *Dimetrodon* from the Theromorpha, and have subsequently included it with the Rhynchocephalians, chiefly on account of this character, and it is possible also that a similar transfer awaits the Endothiodontidæ under similar circumstances. It is to the latter that the Rhynchosaurians appear to bear the greatest resemblance, but in this case also the resemblance may be based upon analogy alone.

The principal conclusions I have arrived at are as follows:—

1. All the bones in the skull of *Hyperodapedon Gordoni*, as seen in the specimen in the British Museum (apart from the occipital region), can be identified, except such as may be still embedded in the matrix.

2. The upper side of the skull agrees with the one known for Rhynchocephalians, with this difference, that the postorbital is rather large and removed in position from the orbital.

3. In the lower jaw five bones can be clearly distinguished, to which an angular should be added, analogous to *Rhynchosaurus*.

4. The maxillaries are edentulous; the palatines possess numerous rows of teeth in serial arrangement, which increase in size from the front to the back. They are not changed, but their number is augmented in their hinder margins; their complete wear is prevented by alteration in the position of the attritive surfaces. The suture between the palate-bone and the maxillary lies to the outside of the dentigerous portion, and is probably the same in the Placodontia.

5. *Hyperodapedon*, together with *Rhynchosaurus*, forms a separate group of the Rhynchocephalians, viz. the Rhynchosaurians, which are connected in a direct line with the lowest forms. This group has no affinity with the Rhynchocephalians in a stricter sense; its analogies with the Chelonians, the Endothiodontidæ, and the Champsosauridæ are physiological ones.

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II.—Notes on some Remains of *Cryptocleidus* from the Kellaways Rock of East Yorkshire.

By Thomas Sheppard, F.G.S.

On visiting Brough a short time ago I noticed a small section had been made on the western slope of Mill Hill, about twenty or thirty feet below the top. The excavation is made in soft white sand, which is very ferruginous in places. Beds of hard sandstone, varying in thickness from one to three inches, traverse it in the upper part of the section. These beds of sandstone are practically horizontal, and contain casts of *Belemnites Owenii, Gryphæa bilobata, Trigonia,* and other characteristic Kellaways Rock fossils. In not a single instance was a portion of a shell remaining, the whole of the calcite having been dissolved away. There is only a thin covering of soil; and this contains numerous pebbles of doubtful origin, and some pieces of Roman pottery.

The excavated material is sent to Leeds, where it is used by an engineering firm for moulding.

On examining the pit I noticed a piece of very ferruginous material. It was of rather peculiar shape, however, and on picking up further pieces it became evident that they were small fragments of bone. They had been thrown on a heap on one side, and such bones as were found had to be picked from this heap; consequently their exact horizon could not be determined. Subsequent visits were the means of finding still further specimens, chiefly whole and broken vertebræ, pieces of ribs, etc. On one of these occasions a vertebra was noticed protruding from the quarry face, at a depth of about seven feet; this was in close proximity to the heap from which the other remains had been obtained. This vertebra was extracted, and several others were found on the same level, fitting close together. These vertebræ were nearly circular, and were without the prominent processes which occurred on some of the earlier specimens found on the refuse heap. Evidently, therefore, this was the tail end of the animal, and unfortunately the most

important remains had already been excavated and were not preserved. However, the find in the quarry face enables the exact horizon of the animal to be fixed, and there can be little doubt that the almost complete skeleton of a huge saurian had been buried, where it had rested undisturbed from the day it was deposited in Jurassic times. The disposition of the remains suggests quiet waters, and subsequent undisturbed conditions.

Below the remains the sand is much whiter and finer, and more resembles the pure white sand exposed in a section near Sancton church, a few miles away.

Having been informed that some time previously, when the bones were first excavated, a few of the larger specimens had been sent to Mr. W. Richardson, of South Cave, I called upon that gentleman and found that he possessed three very large paddle-bones, obviously from the same skeleton as my specimens; these he has been good to hand over to me.

A selection from the collection of bones has been sent to Mr. E. T. Newton, F.R.S., of H.M. Geological Survey, and he has kindly examined the specimens for me. Mr. Newton reports that they "belong to some animal allied to the *Plesiosaurus*, and probably to the one which has been named *Cryptocleidus*, but the broken condition of the specimens prevents a certain determination." Mr. Newton adds, "such reptiles are known from the Oxford Clay, but not from the Kellaways Rock," and in this opinion Mr. C. Fox-Strangways, who has recently completed a volume on the Jurassic Rocks of Yorkshire, concurs.

Twenty-five specimens were sent to Mr. Newton, and he has determined them as under:—

Nos.	1 & 2.	Parts of one paddle-bone, femur or humerus.
,,	3.	Part of another.
,,	4–10.	Pieces of above.
,,	11.	Piece of a jaw.
,,	12.	Paddle ossicles.
,,	13–21.	Portions of vertebræ.
,,	22–25.	Ribs.

No. 11 is very interesting, but unfortunately it is only the anterior half of the lower jaw, and does not contain any teeth.

In addition to the above there are some dozens of pieces of bone, principally vertebræ and ribs.

The condition of the remains is interesting. Being found in a soft sandy deposit they were easily extracted, a chisel not being required. There has been little labour, therefore, in freeing the bones from the matrix, an operation that would have been exceedingly difficult had they been in hard rock. It is no doubt due to the fact that the specimens are very ferruginous (some being almost like cast iron) that they are in such a good state of preservation.

Seeing that remains of *Cryptocleidus* have not previously been recorded from the Kellaways Rock, it would perhaps be as well if a word or two were said on the stratigraphical position of these

particular specimens. The geology of Mill Hill is simple, and may be briefly stated as follows :—

Formations.	Description.	Where Exposed.
1. Superficial Gravels.	Loose waterworn gravel and sand.	In a quarry on the top of the hill.
2. Kellaways Rock.	Hard sandstone with fossils	In the quarry where the Saurian bones occurred.
3. Kellaways Sand.	Ferruginous sands.	
4. Great Oolite Clay or Sandy Oolite.	Sand and clay.	In a well-section lower down the hill.
5. Millepore Oolite.	Hard limestone with fossils.	At the base of the hill.

The fact that thin beds of sandstone, with well-known Kellaways Rock fossils, occur some six feet above the bed containing the remains, clearly indicates that the bones were found in what is known as the Kellaways Sands. These beds are well exposed in the railway cutting at South Cave, a short distance away, though of this section Mr. Fox-Strangways says,[1] "the beds [of the Great Oolite Clay] are so similar to the sands of the Kellaways Rock above that it is difficult to fix an exact horizon between them."

The question arises, does the lower part of the section on Mill Hill, in which the *Cryptocleidus* remains were found, belong to the Kellaways Sands or the Great Oolite Clay series? The beds of the Great Oolite Clay (sometimes called the 'Sandy Oolite') consist mostly of sands, clayey in parts.[2] This rock, however, occurs further down the hill. In a previous paper[3] I have described a well section that was being made in 1895, which was sunk in the Great Oolite Clay. It showed six feet of stiff blue clay, greatly mottled and stained with yellow, containing no fossils or stones. Below this was about three feet of yellow clay; the standing water prevented me from seeing further, but at one end of the heap of excavated material at the top of the well was a quantity of fine yellow sand, which had no doubt been taken from below the yellow clay. This section was some distance down the hill.

At the bottom of Mill Hill are some small exposures in the Millepore Oolite, whilst at the top I have frequently observed slabs of Kellaways Rock in the floor of the gravel-pit, hard masses of this rock evidently occurring in a few places towards the top of the hill. Taking all into consideration, therefore, there can be little doubt that the Saurian occurred in the Kellaways Sand, and the discovery of these relics of *Cryptocleidus* give that animal a much earlier and longer period of sojourn upon this earth than previous records, from the Oxford Clay, have warranted.

In searching for records of similar finds previously obtained from

[1] "The Geology of the Country between York and Hull": Geol. Survey Mem., 1886, p. 22.

[2] Loc. cit., p. 22.

[3] "Notes on *Elephas antiquus* and other remains from the Gravels at Elloughton, near Brough, East Yorkshire": Proc. Yorks. Geol. and Polyt. Soc., 1897, p. 222.

the Kellaways series, I noticed that Phillips, in his "Geology of Yorkshire,"[1] in a list of "Fossils from the Kellaways Rock," refers to a "coracoid bone? of a saurian animal," and this is the only record of any kind that I have been able to find. I thought it possible that the specimen referred to by Phillips might be in the York Museum. On communicating with Mr. Platnauer, the Curator, however, on the matter, he states — "Phillips' 'Undetermined Coracoid' from the Kellaways is not in our Museum. Indeed, our collections have no vertebrate remains from the Kellaways Rock at all."

It should be mentioned that whilst at Scarborough recently I noticed two lumps of hard ferruginous rock in the Museum grounds, the matrix and general appearance of which very much resembled that of the Kellaways Rock, which is exposed in several places in the neighbourhood. Each piece on its broken face exhibited the section of a huge bone, somewhat resembling the paddle-bones from Mill Hill, just described. A portion of an articular surface also protruded from one of the pieces. Of course it is possible that these two Scarborough blocks were found together in the Kellaways Rock, and it is not even improbable that they represent the specimens referred to by Phillips. In the absence of labels or other information, however, we are left in the dark on these points, but it seems desirable that the specimens should be recorded.

III.—Coal Plants. Incontrovertible Evidence of Growth *in situ*.

By W. S. Gresley, F.G.S., F.G.S.A.

THE fossils to which this communication relates were described and the deductions drawn from their mode of occurrence in a paper I submitted to the Geological Society of London in 1896, but as that paper was not printed *in extenso* (see Q.J.G.S., vol. liii, p. 245), with the Editor's kind permission the gist of it appears as follows.

I am not aware that entirely satisfactory evidence showing that any of the coal-forming plants[2] grew exactly where they occur to-day as fossils, has as yet been produced. What authenticated cases of demonstrated growth-in-place coal-forming plants have been admitted by reliable or competent workers and teachers in this connection? While many instances of tree stumps with root-processes and other forms of vegetation more or less in contact with beds of coal have been cited in many countries, in no case do they seem to have contributed coal to the seam, or been found to be composed of but little else than material foreign to coal (stone, pyrites, clay, shale, etc.). Many trustworthy observers have pointed out the danger in taking it for granted that erect fossil stumps met

[1] 1829 edition, p. 142.

[2] The term 'coal-forming' used in this paper means entering more or less extensively into, or contributing, material of a coal-like aspect and chemical composition, practically the same as the coal-bed in which occurring, with which to help to pile up or add thickness to the seam.

with in or upon (very rarely *in*) a coal-bed grew where they now are; but if a case of growth in place in coal has been or can be established, notwithstanding the substance of the fossil is rock or shale, nobody will dispute that the tree or the plant, whatever it was, did contribute some coaly material to the coal-bed in which it flourished. Be this as it may, the object of this paper is to record the occurrence of forms or fossils composed of coal in actual contact with beds of coal, that unquestionably were plants that grew absolutely *in sitû*, and thus to establish the fact that some coal-seams, and typical ones too, are partly, at any rate, composed of vegetal remains that have lived and died exactly on the spots now occupied by them. I also want to make it quite evident that the forms to which special reference is here made grew under water.

Fig. 1.—Section of Coal and Clay-slate.

The coal-seam A, Fig. 1 (the uppermost few inches of which appear), is about 6 feet thick: it is overlain by a layer of black, tough shale (called 'bone'), B, which is about 2 inches thick. Over this 'bone' comes 10 to 11 inches of mottled fireclay, C, and the clay is followed by strata of coal and shale for several feet. These alternations of Coal-measures (Carboniferous), with trifling local differences, obtain for a very large portion of the area of the seam, which is the 'Pittsburg' bed in S.W. Pennsylvania.

An examination of the horizon A–A′—the top of the seam of coal proper—reveals the phenomenon of the bright, brittle, pitch-like coal laminæ, sending out, or more properly, having developed, upward swellings, expansions, and horn-like processes D, not only into the black shale B, but also into the clay C, and in those two strata dividing, branching, curving, and expanding in a peculiar but uniformly characteristic manner. This phenomenon is a very common one; and since these coaly forms extend very much farther horizontally than vertically, and possess their limbs, lobes, expansions, branches, leaves, or whatever their parts or processes should be called, in ever varying shape, position, and trend, any section or exposure of them shows change and difference in form. In some places they appear in great profusion, in others are scattered or of less development and therefore less conspicuous. As to chemical composition and physical aspect, these strange meandering forms in the top of the coal-seam differ but little, if at all, from the black brittle

laminæ lower down in the seam, where the forking and curving phenomena are very much less in evidence. Occasionally one notices suggestions of a core or centre in these fossils—a little clay or pyrites, for instance—but the majority of them are composed of compact, bright, brittle, apparently structureless coal. The exteriors, when the fossils enter the clay, are always filmed with clay, but seem quite devoid of markings—are very smooth. A noticeable feature of the terminals or extremities of the leaves or processes is a tendency to thicken or become slightly bulbous there. Complete pockets of clay are sometimes seen in them. When embedded in the coal-seam they cannot be separated from the matrix. The longest individual measured over 12 feet; the thickest part of any one, about 4 inches,—and all compact coal. Rarely one reaches to the base of the coal above the fireclay C; and here and there specimens seem wholly in the latter stratum. From an examination of a very large number of these forms, extending over many years of my professional work (that of a mining engineer), underground in coal-mines and in clay-mines, as well as in open-cast workings in coal and fireclay districts, my conclusion is that in *form* or *shape* these fossils resemble, more than anything else I know of, the fronds of the Elk-horn fern. Fish teeth, scales, etc., have been found in contact with these coaly forms.

Viewed or regarded as veins, or in a purely stratigraphical and physical light, wholly apart from botanical considerations, these forms or shapes of coaly material, since they intersect the beds B and C, would be regarded as having been formed there or placed there *since* those beds were deposited. But as those forms are presumed to be of vegetable origin, fossil plants or parts of plants which evidently contributed coal to the seams A–A′, two explanations of their origin are possible, viz.: (1) That they are the drifted and buried remnants of shrunk-up parts of trees, etc.; and (2) that they are plants which grew and died where they now are. If the former,

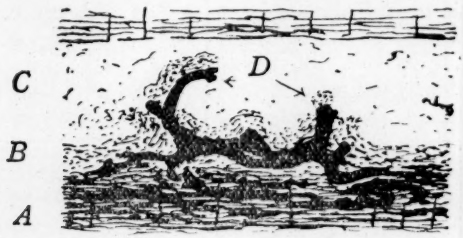


Fig. 2.

then they became buried before the coal A was fully accumulated, and therefore before B and before C were deposited; if the latter, then we ought to find some tangible proof of the fact in connection with them. That there is this proof is the burden of this paper—of my argument. When these forms or fossils are strongly in evidence and protrude stout processes up into the clay C, two things are

noticeable: one is that the black shale or 'bone' bed is, as it were, ploughed up and overturned along the sides of the coaly intruders (see Fig. 2); and the other is that ruptured masses of the 'bone' are seen to lie upon the backs and tops of the more prominent expansions (see D, Fig. 2), making it perfectly plain that these plants, in pushing their way upwards, carried patches or strips of the layer B with them in the water (they must have been under water) or slime in which they were growing. I fail to see how one could wish for a more striking demonstration of expansive or upward growth of plants *absolutely in place of growth* than such as this figure is typical of. What other explanation, I ask, will be satisfactory?

But if we would attempt to account for this phenomenon by supposing the forms were in place before the bone layer was deposited, its deposition would have been a horizontal, even, or unbroken one, and the projecting (? woody) processes, such as D, Fig. 2, would have stood up through or been left bare of it, as suggested in Fig. 1. But we are not left to conjecture upon this point. Look at the conditions or the phenomenon sketched in Fig. 3,

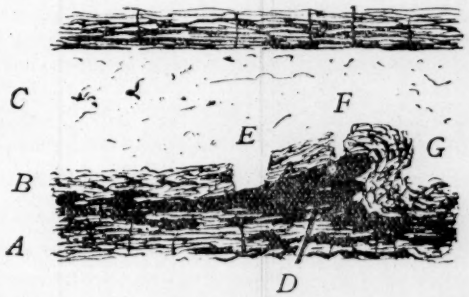


Fig. 3.

for clearly here we have one of these forms, D, actually arrested as it were in the act of rupturing the bone layer B. That that stratum was undergoing lateral stretching, amounting to tearing it asunder at E and F, as well as crumpling or thrusting it aside at G, when overwhelmed or when solidification took place, and that the cause of the rending and twisting was the lateral thrust from the extension towards G of the form, or coal-plant growth, D, is to my mind perfectly clear, admitting of no other explanation when taken in conjunction with the phenomena illustrated in Figs. 1 and 2, besides other facts to be noted.

Having these forms of coaly material interlaminated or interstratified with the body of the coal-seam in a descending direction, and inseparably connected stratigraphically and physically in the opposite direction with the beds immediately overlying the coal-seam, to draw a hard and fast line between the coal-bed and the clay above it is impossible. The conclusion, then, is, that growth *in sitû*, for *a part* at least, of the seam of coal, must be granted, even by those who would prefer what we call the 'drift theory.' Another

point that seems to admit of no question is this: that since these coaly forms grew in place, that 'place' cannot have been other than under water, for the reason that the black slime, the stratum B, must have been an aquatic deposit: so that our 'coaly forms' were denizens of mud and presumably of water too.

Other facts may be cited in this connection. The underclay or 'seat earth' of the No. 2 coal-bed in Illinois—a seam far-reaching in extent and of wonderfully uniform thickness and character as regards floor, coal, and roof—in very many places is penetrated by 'coaly forms' possessing the same facies and characteristics as those we have been considering in the 'Pittsburg' seam. If the reader will look at Figs. 1, 2, and 3 upside down, and disregard the bed B, the general aspect of these forms, in vertical sections, will appear. In other words, they are *grown* to the coal-bed, and protrude twisty and horny sheets of compact bright coal in every variety of shape and direction into the underclay; thus making it evident that they were formed exactly where they are now, and that some of the laminations of the coal-bed also, as plants or parts of plants, lived and died in place of growth. The characteristic markings of *Stigmaria* have also been observed in this underclay, but so totally different are the two fossils or objects and their state of preservation, that to get confused in tracing them is impossible. Here, then, also we cannot escape the inference that these coaly forms were plants of aquatic habitat; and although admitting some shrinkage or reduction in bulk to have taken place during conversion from vegetal matter into brittle material resembling coal, it is evident that comparatively little shrinkage did obtain.

Besides the above localities that have produced this kind of coal-bed formation phenomena, the author has discovered very similar fossils in contact with three or four coal-beds in the Leicestershire and South Derbyshire Coalfield; in fact, it was in the mines in this district that they first attracted his attention.

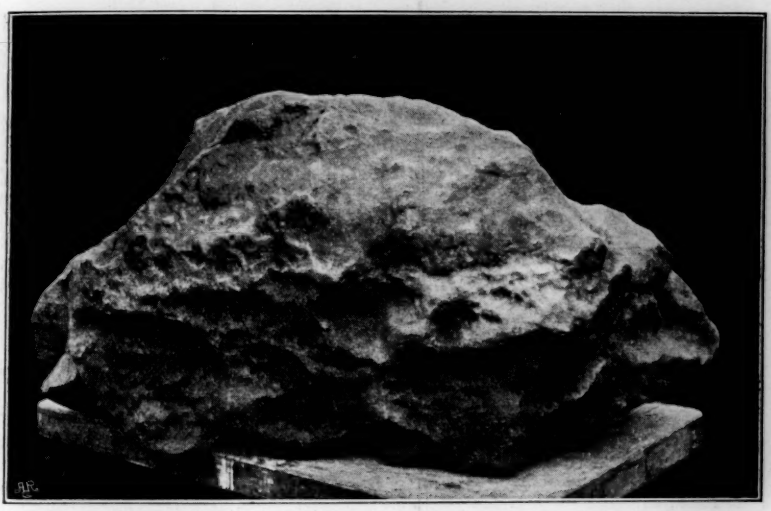
Doubtless similar forms exist in other regions, and the discovery and study of them will yet furnish valuable facts in this line. I am fully aware that if the palæobotanist and microscopist were to pass judgment on my observations and conclusions, they would say the case was 'not proven'; but my contention or claim is this: that no matter what the anatomy and internal organization of these forms was and may yet be found to show, the stratigraphical evidence is clearly pronounced, unmistakable, and altogether in favour of my contention. Further, I hold this: that *science* does not demand a demonstration—a knowledge—of the anatomical structure of an extinct plant or animal to prove or claim the existence or discovery of a new species or genus when *the shape or form* (cast or mould, etc.) of such make it evident that something new has turned up. But *time* will show whether or not I have come upon something new or important in this interesting question of coal-bed formation. If I have made my claim good, it is for those who may refuse to accept it to show that these fossils did not have the attributes and environment herein described or suggested.

IV.—A Greywether at South Kensington.

By H. B. Woodward, F.R.S.

In the Geological Magazine for March, 1891, p. 119, I drew attention to the occurrence of a large Greywether in Moscow Street, Bayswater. Another and smaller example has lately been discovered in the foundations for the new buildings of the Victoria and Albert Museum, South Kensington. The excavations show:

Made ground and soil, about 5 feet.
Gravel, full thickness about 20 feet.
London Clay with cement stones.



Greywether or Sarsen-stone from the Gravel. Victoria and Albert Museum, South Kensington. (One-twelfth natural size.)

The Greywether was found at the south-western part of the site, ten feet from the surface, and at a depth of five feet below the top of the undisturbed gravel. In size it is 3 ft. 10 in. by 3 ft. 3 in. and 2 ft., according to the greatest measurements, but the stone is somewhat irregular in shape and the bulk is less than these full measurements would indicate.[1] The stone is a somewhat coarse sandstone, with the grains more distinct than in many examples of Greywether or Sarsen-stone. One side is much smoothed and almost polished, as if by wind-drifted sand. The block may have been formed in the Bagshot Sand, and may have long remained on the surface of the land in Pre-Glacial times, a relic of Eocene strata the denudation of which took place partly during the Miocene and

[1] Mr. C. Barlow, Mason-Formatore in the Geological Department, estimates the cubic contents of the 'Sarsen-stone' at from 10 to 11 feet, and its weight from 13 cwt. to 14 cwt.

Pliocene periods. It may have been shifted and incorporated in glacial drift, and afterwards dislodged and transported by river-ice, and thus transferred to the wide-spreading gravels of the Thames Valley. It is, however, impossible to speak precisely of its past history. The fact of its occurrence is interesting, as Mr. Whitaker has remarked that such blocks "occur somewhat rarely in our River Gravel." An example fully three feet across was, however, noticed by Mr. J. Allen Brown at Alperton, in the Brent Valley, and other records have been published.[1]

The specimen to which attention is now directed was observed by Colonel C. K. Bushe, F.G.S., and he lost no time in securing it and in presenting it to the British Museum of Natural History, Cromwell Road, where it will be preserved and placed in the Garden on the eastern side near the Fossil Tree from Craigleith, Edinburgh, and not very far from the spot where it was discovered in the Gravel.

V.—Pleistocene Shells from the Raised Beach Deposits of the Red Sea.

By R. Bullen Newton, F.G.S., of the British Museum (Natural History).

(*Concluded from the November Number, p.* 514.)

(PLATES XX–XXII.)

Family CONIDÆ.

Conus flavidus, Lamarck.

Conus flavidus, Lamarck: Hist. Nat. Anim. sans Vert., vol. vii (1822), p. 468.

Distribution.—Red Sea, East Africa, Ceylon, Java, etc. (Tryon); Red Sea, Persian Gulf, East Africa, Polynesia, Fiji Islands, etc. (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (Nos. 1,651, 1652, Box No. 79*j*).

Conus miliaris, Hwass.

Conus miliaris, Hwass.: Encyclop. Méthodique, 1792, vol. i (vers), p. 629.

Distribution.—Red Sea to Sandwich Islands (Tryon). Coll. Geol. Surv. Egypt: beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*).

Conus monachus, Linnæus.

Conus monachus, Linnæus: Systema Naturæ, 10th ed. (1758), p. 714.

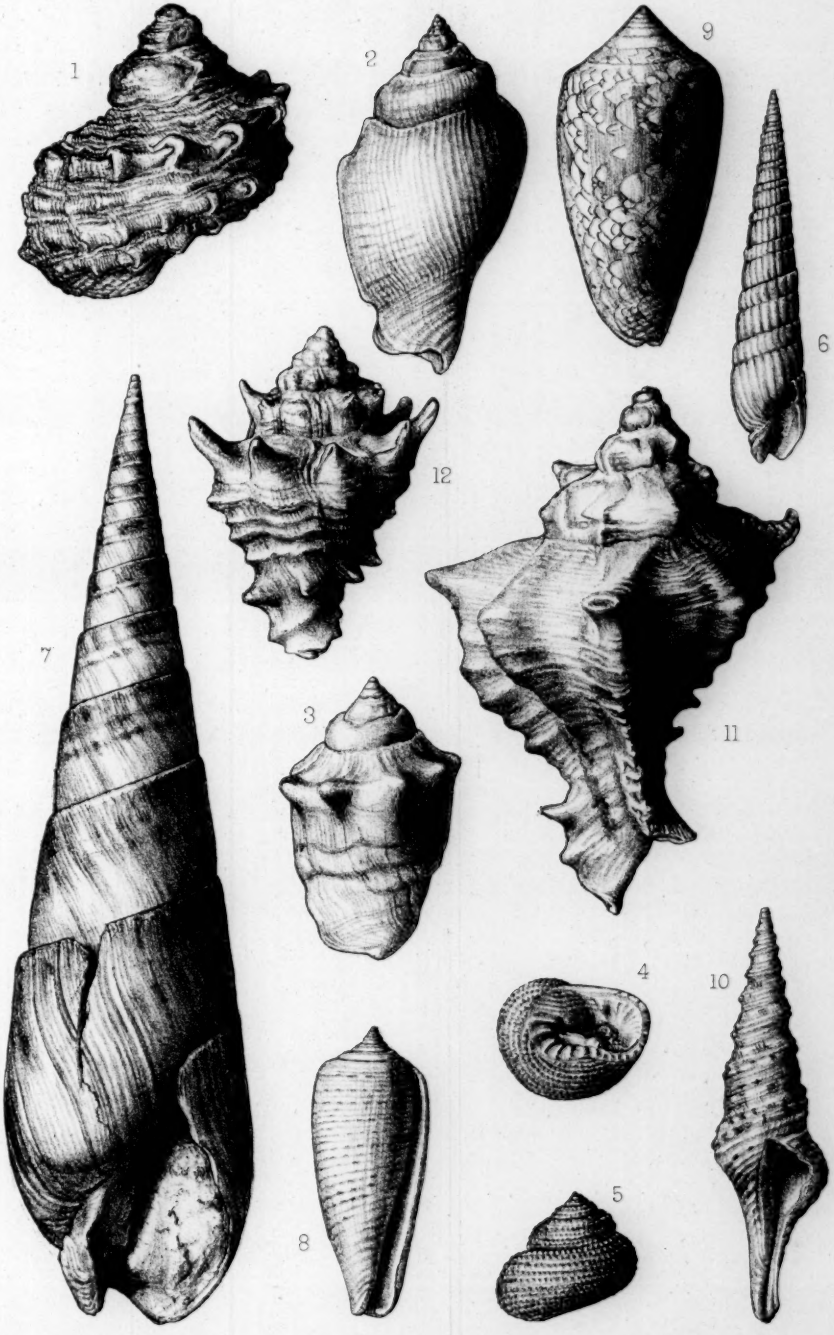
Distribution.—Philippines and New Caledonia (Tryon). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (Nos. 1,651, 1,652, Box No. 79*j*); raised beach, Camp 6, Wadi Gueh (Nos. 1,591 and 1,567, Box No. 30*k*).

Conus nussatella, Linnæus. (Pl. XX, Fig. 8.)

Conus nussatella, Linnæus: Systema Naturæ, 10th ed. (1758), p. 716.

Distribution.—Beach deposits of Red Sea (Gray & Frembley, Issel); Red Sea to Polynesia (Tryon); Aden, Red Sea, East Africa, Ceylon, Java, Philippines, North Australia, Polynesia (E. A. Smith). Coll. Geol. Surv. Egypt: beach east of Gharib (Nos. 2,227–2,254,

[1] See Whitaker: "Geology of London," vol. i, pp. 330, 362, 449 etc.



G.M. Woodward del. et lith. West, Newman imp.

Modern Shells from Red Sea Beach deposits.

Box No. 17*j*); raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*); raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (Nos. 1,653, 1,654, Box No. 80*j*); raised beach, Wadi Gueh, Camp 6 (Nos. 1,591 and 1,567, Box No. 30*k*).

Conus omaria, Hwass. (Pl. XX, Fig. 9.)

Conus omaria, Hwass.: Encyclop. Méthodique, 1792, vol. i (vers), p. 743 (=*pennaceus*, Born, *vide* Tryon).

Distribution.—Red Sea, Philippines (Tryon). Coll. Geol. Surv. Egypt: 50 foot beach, Gemsah (Nos. 2,031–2,057, Box No. 58*j*); raised beach, Camp 6, Wadi Gueh (Nos. 1,591 and 1,567, Box No. 30*k*).

Conus generalis, Linnæus.

Conus generalis, Linnæus: Systema Naturæ, 12th ed. (1767), vol. i, pt. 2, p. 1,166.

Distribution.—Beach deposits of the western shore of Red Sea (Gray & Frembley); Red Sea, Ceylon, East Africa, Philippines, New Caledonia (Tryon); Aden, Red Sea, Ceylon, East Africa, Philippines, etc. (E. A. Smith). Coll. Geol. Surv. Egypt: Ras Gharib (Barron).

Conus textile, Linnæus.

Conus textile, Linnæus: Systema Naturæ, 10th ed. (1758), p. 717.

Distribution.—Red Sea, Indian Ocean, Philippines, Polynesia, Aden (E. A. Smith); beach deposits, western borders of Red Sea (Gray & Frembley); Red Sea, Mauritius, Philippines, etc. (Tryon). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 5, Wadi Gueh (No. 1,608, Box No. 54*k*).

Conus tessellatus, Bruguière.

Conus tessellatus, Bruguière: Encyclop. Méthodique, 1792, pl. cccxxvi, fig. 7.

Distribution.—Beach deposits, western shores of Red Sea (Gray and Frembley); Gulf of Akaba and Red Sea beach deposits (Issel); Aden, Pidang, Sumatra (E. A. Smith); Red Sea (B.M.); Red Sea, Mauritius, Ceylon, Philippines, etc. (Tryon). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 5, Wadi Gueh (No. 1,608, Box No. 54*k*).

Conus virgo, var. **emaciatus**, Reeve.

Conus virgo, Linnæus: Systema Naturæ, 10th ed. (1758), p. 713.
Conus emaciatus, Reeve: Conchologia Iconica, 1849, Suppl., pl. v, fig. 248.

Distribution.—Philippines (B.M.); Java, Philippines, Australia, Polynesia (Tryon). Coll. Geol. Surv. Egypt: raised beach, Wadi Gueh, Camp 6 (Nos. 1,591 and 1,567, Box No. 30*k*).

Family BULLIDÆ.

Bulla ampulla, Linnæus.

Bulla ampulla, Linnæus: Systema Naturæ, 10th ed. (1758), p. 727.

Distribution.—Beach deposits western borders of Red Sea (Gray and Frembley); desert of Attaka, near Suez (Issel); Aden, Indian and Pacific Oceans (E. A. Smith). Coll. Geol. Surv. Egypt: Jebel Zeit (Barron); raised beach 20 feet above sea at Gharib lighthouse

(Nos. 2,058–2,098, Box No. 18*j*); beach against old island west of Camp 51, south of Gharib lighthouse (Nos. 2,021–2,030, Box No. 57*j*); raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (Nos. 1,651, 1,652, Box No. 79*j*).

Class SCAPHOPODA.

Family DENTALIIDÆ.

Dentalium octogonum, Lamarck.

Dentalium octogonum, Lamarck: Hist. Nat. Anim. sans Vert., vol. v (1818), p. 344.

Distribution.—Red Sea and Persian Gulf, and Red Sea beach deposits (Issel). Coll. Geol. Surv. Egypt: Ras Gharib (Barron); raised beach 20 feet above sea, Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*).

Class LAMELLIBRANCHIATA.

Family ARCIDÆ.

Arca imbricata, Bruguière.

Arca imbricata, Bruguière: Encyclop. Méthodique, 1789, vol. i (vers), p. 98.

Distribution.—West Indies, Fernando Noronha, South Africa, Indian Ocean, Australia, Aden (E. A. Smith); Philippines, Zanzibar, etc. (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*); 50 foot beach, Gemsah (Nos. 2,031–2,057, Box No. 58*j*); raised beach, Camp 6, Wadi Gueh (Nos. 1,562 and 1,564, Box No. 61*k*).

Arca rotundicostata, Reeve.

Arca rotundicostata, Reeve: Conchologia Iconica, vol. ii (1844), pl. vii, fig. 46.

Distribution.—Locality unknown (B.M.). Coll. Geol. Surv. Egypt: plain between Ras Gemsah and Jebel Zeit (No. 2,224, Box No. 12*j*).

Arca squamosa, Lamarck.

Arca squamosa, Lamarck: Hist. Nat. Anim. sans Vert., 1819, p. 45, vol. vi, pt. 1.

Distribution.—Suez, Australia (Issel). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*).

Anadara antiquata, Linnæus. (Pl. XXI, Fig. 6.)

Arca antiquata, Linnæus: Systema Naturæ, 10th ed. (1758), p. 694.

Distribution.—Beach deposits, western shore of Red Sea (Gray and Frembley); Australia, Indian Ocean, Mozambique (E. A. Smith). Coll. Geol. Surv. Egypt: Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (No. 1,644, Box No. 74*j*); raised beach, Camp 6, Wadi Gueh (No. 1,601, Box No. 56*k*; Nos. 1,562 and 1,564, Box No. 61*k*).

Anadara radiata, Reeve.

Arca radiata, Reeve: Conchologia Iconica, vol. ii (1844), pl. vi, fig. 40 (=*scapha*, Issel, *non* Chemnitz).

Distribution.—Gulf of Akaba, Suez (Issel). Coll. Geol. Surv. Egypt: plain between Ras Gemsah and Jebel Zeit (No. 2,223, Box

No. 9*j*); young forms from raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*); 50 foot beach, Gemsah (Nos. 2,031–2,057, Box No. 58*j*); beach No. 2, north-west of Camp 40, plain east of Jebel Mellaha, east of Red Sea Hills (No. 2,256, Box No. 26*h*); Ras Shokair, west coast of the Gulf of Suez, north-east of Camp 50 (No. 2,267, Box No. 37*h*).

Barbatia lima, Reeve.

Arca lima, Reeve: Conchologia Iconica, vol. ii (1844), pl. xv, fig. 101.

Distribution.—Philippine Islands, Cape York, Aden (E. A. Smith). Coll. Geol. Surv. Egypt: beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*); raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*; Nos. 2,090–2,105, Box No. 20*j*); raised beach, Camp 6, Wadi Gueh (No. 1,601, Box No. 56*k*; Nos. 1,562 and 1,564, Box No. 61*k*).

Glycymeris[1] **pectunculus**, Linnæus. (Pl. XXI, Fig. 7.)

Arca pectunculus, Linnæus: Systema Naturæ, 10th ed. (1758), p. 695 (=*pectiniformis*, Lamarck).

Distribution.—Bengal, Suez Bay, Gulf of Akaba, Persian Gulf, Madagascar (E. A. Smith); beach deposits, western shore of Red Sea (Gray & Frembley, Issel); Gulf of Akaba, Suez Bay, Philippines (Issel). Coll. Geol. Surv. Egypt: beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*); Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); 50 foot beach, Gemsah (No. 2,043, Box No. 63*j*); big bay south of Sherm, Sinai (No. 3.527, Box No. 44*l*); a young form from raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*).

Family MYTILIDÆ.

Septifer bilocularis, Linnæus.

Mytilus bilocularis, Linnæus: Systema Naturæ, 10th ed. (1758), p. 705.

Distribution.—Africa, etc. (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*).

Septifer excisus, Wiegmann.

Tichogonia excisa, Wiegmann: Archiv Naturgeschichte (Wiegmann), 1837, p. 49.

Distribution.—Beach deposits of the Red Sea (Issel); Aden, Madagascar, Mauritius, Mozambique, etc. (E. A. Smith). Coll. Geol. Surv. Egypt: beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*).

Volsella[2] **auriculata**, Krauss.

Modiola auriculata, Krauss: Die Südafrikanischen Mollusken, 1848, p. 20, pl. ii, fig. 4.

Distribution.—Aden, South and East Africa, Gulf of Suez (E. A. Smith); Red Sea (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea, Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*).

[1] *Glycymeris*, Da Costa, 1778=*Pectunculus*, Lamarck, 1799, and *Axinæa*, Poli, 1795.

[2] *Volsella*, Scopoli, 1777=*Modiolus*, Lamarck, 1799.

Lithophaga Avitensis, Mayer-Eymar.

Lithodomus Avitensis, Mayer-Eymar, in Hörnes' "Foss. Moll. Tert.-Beck. Wien.": Abhandl. k.k. geol. Reichs., 1867, p. 354, pl. xlv, fig. 12.

This species is represented by some excellent casts showing ornamentation and form.

Distribution.—Miocene of Germany (Mayer-Eymar); Pliocene of Italy (Pantanelli, etc.). Coll. Geol. Surv. Egypt: Ras Shokhair, west coast of the Gulf of Suez, north-east of Camp 50 (No. 2,265, Box No. 35*h*); raised beach 380 feet above sea, near Camp 7, Wadi Shigeleh (No. 1,662, Box No. 64*k*).

Lithophaga Lessepsianus? Vaillant.

Savigny's Desc. de l'Egypte, 1817, pl. xi, fig. 3.
Lithophagus Lessepsianus, Vaillant: Journ. Conchyliologie, 1865, p. 115.

Represented by a cluster of young forms in coral crypts, resting on matrix, probably belonging to this species.

Distribution. — Gulf of Suez (Vaillant). Coll. Geol. Surv. Egypt: raised beach north of Kosseir (No. 2,111, Box No. 46*j*).

Lithophaga Lyellanus, Mayer-Eymar.

Lithodomus Lyellanus, Mayer-Eymar: in Hartung's "Geol. Beschr. Madeira," 1864, p. 218, pl. iv, fig. 23.

A species of less cylindrical shape than *L. Avitensis*, otherwise closely related; represented by casts only.

Distribution.—Tertiary: Madeira (Mayer-Eymar). Coll. Geol. Surv. Egypt: raised beach north of Kosseir (Nos. 2,121–2,138, Box No. 50*j*).

Family OSTREIDÆ.

Alectryonia cucullata? Born.

Ostrea cucullata, Born: Testacea Mus. Cæsarei Vindobonensis, 1780, p. 114, pl. vi, figs. 11, 12.

Represented by some young examples of a plicated oyster, which may probably belong to this species.

Distribution.—Red Sea, etc.; and in the later Tertiary formations of Italy, Algeria, Egypt, etc. Coll. Geol. Surv. Egypt: raised beach 20 feet above sea, Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*; Nos. 2,090–2,105, Box No. 20*j*).

Alectryonia crenulifera, G. B. Sowerby.

Ostrea crenulifera, G. B. Sowerby: Conchologia Iconica, vol. xviii (1871), pl. xxvii, fig. 67.

An example consisting of a single valve externally covered with several small Balani.

Distribution.—Red Sea (B.M. and G. B. Sowerby). Coll. Geol. Surv. Egypt: raised beach north of Kosseir (Nos. 2,121–2,138, Box No. 50*j*).

Alectryonia plicatula, Gmelin.

Ostrea plicatula, Gmelin: Systema Naturæ, 13th ed. (1790), p. 3,336.

Distribution. — Mediterranean, Atlantic and Indian Ocean; Miocene to Saharian of Italy, Egypt, etc. (Mayer-Eymar). Coll. Geol. Surv. Egypt: raised beach north of Kosseir; an adult

specimen and some young forms (No. 2,109, Box No. 32*j*; Nos. 2,121–2,138, Box No. 50*j*).

Alectryonia, allied to **crista-galli**, Linnæus. (Pl. XXII, Figs. 5, 6.)

Mytilus crista-galli, Linnæus: Systema Naturæ, 10th ed. (1758), p. 704.

A short, deeply plicated form, ornamented with wide transverse lamellæ. Cardinal line horizontal, with a small central triangular ligamental area. There is only one specimen of this shell in the collection, both valves being in contact, one being rather fragmentary. It is, however, particularly well marked, and appears to be intermediate between *A. crista-galli* and *A. turbinata*, Lamarck (Hist. Nat. Anim. sans Vert., 1819, vol. vi, pt. 1, p. 212), both of which are Indian Ocean species and prominently plicated. This example is probably an extinct form.

Dimensions.—Height 45 mm., width about 40 mm.

Coll. Geol. Surv. Egypt: raised beach north of Kosseir (Nos. 2,121–2,138, Box No. 50*j*).

Alectryonia Virleti, Deshayes.

Ostrea Virleti, Deshayes: Expéd. Sci. Morée, vol. iii (1833), pt. 1 (Mollusques), pp. 122–124, pl. xxi, figs. 1–6.

This species is accompanied by casts of *Anadara radiata*, *Dosinia radiata*, *Lævicardium* like *oblongum*, etc.

Distribution.—Miocene of Morea (Deshayes); Armenia (Abich); Persia (Fuchs); Egypt (Fuchs, etc.); Pliocene of Italy (Gregorio, etc.). Coll. Geol. Surv. Egypt: plain east of Jebel Mellaha, low range east of Red Sea Hills (No. 2,255, Box No. 33*h*); beach No. 2, north-west of Camp 40, plain east of Jebel Mellaha, east of Red Sea Hills (No. 2,193, Box No. 30*h*); foothills of Jebel Dara, Wadi Dara (No. 2,261, Box No. 3*h*). The specimen from the last-mentioned locality consists of a fragmentary valve, and is therefore of doubtful determination.

Family PECTINIDÆ.

Pecten lividus, Lamarck.

Pecten lividus, Lamarck: Hist. Nat. Anim. sans Vert., vol. vi (1819), pt. 1, p. 178.

A fragment of this species partly encrusted with a small form of *Balanus*.

Distribution.—Red Sea, Mauritius, Aden (E. A. Smith); Red Sea (Issel). Coll. Geol. Surv. Egypt: raised beach north of Kosseir (Nos. 2,121–2,138, Box No. 50*j*).

Pecten Vasseli, Fuchs. (Pl. XXII, Figs. 7–9.)

Pecten Vasseli, Fuchs: Denksch. Math. nat. Cl. k. Ak. Wiss., vol. xxxviii (1877), p. 40, pl. ii, fig. 3.

Syn. *Pecten radula*, var. *subfossilis*, Fraas: Aus dem Orient, 1867, p. 189.

This species is distinct from all others, and is not known in existing seas. It is a rounded, shallow shell, characterized by possessing dichotomizing ribs, which, together with the intermediate grooves, are finely sculptured with almost microscopic, closely-set, transverse striations. In worn examples the striæ are scarcely evident on the ribs themselves. Dimensions of an adult lower valve: height 57, width 63, depth 15 mm.

Distribution. — Pleistocene deposits from near Kosseir (Fraas) and the Bitter Lakes (Fuchs). Coll. Geol. Surv. Egypt: raised beach north of Kosseir (Nos. 2,121–2,138, Box No. 50*j*); raised beach, Northern Wadi Gueh, Camp 6, 240 feet above sea (No. 1,636, Box No. 22*k*); upper coral terrace (*Pecten*-bed) between Nebk and Sherm, South-East Sinai (No. 3,540, Box No. 40*l*).

Chlamys Reissi, Bronn. (Pl. XXII, Fig. 10.)

Hinnites Reissi, Bronn: Reiss' "Santa Maria," in Neues Jahrb., 1862, p. 44, pl. i, fig. 18.

Pecten Reissi, Mayer-Eymar: in Hartung's "Geol. Besch. Madeira," etc., 1864, p. 227, pl. v, fig. 32.

Testa subæquivalvi rotundato-oblonga, compressa, costis radiantibus circiter 30, *inæqualibus, irregularibusque, rotundatis; squamulosis, sæpe binis; auriculis inæqualibus radiatis, antica majori, obliqua.* (Mayer-Eymar.)

The numerous elevated, rounded costæ, covered with close squamulose ornamentation, appear to be the distinguishing features of this shell. The structural characters are well displayed in the specimen figured, although the marginal line has been fractured in places, and a central breakage rather spoils its otherwise elegant appearance.

Dimensions.—Height 46, width 42 mm.

Distribution. — Modern limestone of the Azores and Madeira (Bronn, Mayer-Eymar, etc.) and near Kosseir (Fraas). Coll. Geol. Surv. Egypt: raised beach north of Kosseir (Nos. 2,121–2,138, Box No. 50*j*); raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64).

Chlamys varia, Linnæus.

Ostrea varia, Linnæus: Systema Naturæ, 10th ed. (1758), p. 698.

Distribution.—Recent in the Mediterranean, etc.; Tertiary of Italy and other parts of Europe. Coll. Geol. Surv. Egypt: raised beach north of Kosseir (No. 2,111, Box No. 46*j*).

Chlamys (Gigantopecten) latissima, Brocchi.

Ostrea latissima, Brocchi: Conch. Foss. Subapennina, vol. ii (1814), p. 581.

The specimens are small and apparently very young forms.

Distribution. — Species extinct, and ranging from Miocene (Helvetian) to Pleistocene times (Mayer-Eymar, etc.). Coll. Geol. Surv. Egypt: raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*); *Pecten*-bed, upper coral terrace between Nebk and Sherm, south-east of Sinai (No. 3,540, Box No. 40*l*).

Chlamys (Æquipecten) opercularis, Linnæus.

Ostrea opercularis, Linnæus: Systema Naturæ, 10th ed. (1758), p. 698.

A fragmentary specimen, exhibiting the usual structure of this species, associated with *Pecten Vasseli* of Fuchs.

Distribution.—Recent in the Mediterranean and other European seas, and ranging from Miocene (Helvetian) to Pleistocene times (Mayer-Eymar, etc.). Coll. Geol. Surv. Egypt: raised beach, Northern Wadi Gueh, Camp 6, 240 feet above sea (No. 1,636, Box No. 22*k*).

Family SPONDYLIDÆ.

Spondylus aculeatus, Chemnitz.

Spondylus aculeatus, Chemnitz: Conchylien-Cabinet, vol. vii (1784), p. 74, pl. xliv, fig. 460.

Distribution.—Beach deposits, Red Sea (Issel); Suez Bay, Gulf of Akaba (Issel). Coll. Geol. Surv. Egypt: 50 foot beach at Gemsah (Nos. 2,034–2,036, Box No. 61*j*); Recent beach west of Jebel Zeit (No. 2,157, Box No. 72*j*).

Spondylus, sp. indet. (A fragmentary valve.)

Distribution.—Coll. Geol. Surv. Egypt: 50 foot beach at Gemsah (No. 2,038, Box No. 62*j*).

Plicatula ramosa, Lamarck.

Plicatula ramosa, Lamarck: Hist. Nat. Anim. sans Vert., vol. vi (1819), pt. 1, p. 184.

Distribution. — Beach deposits of the Red Sea (Issel); Enruk Katah el Kebir and desert of Attaka, etc. (Issel). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*; Nos. 2,090–2,105, Box No. 20*j*); Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); beach against old island west of Camp 51, south of Gharib lighthouse (Nos. 2,021–2,030, Box No. 57*j*).

Mantellum (allied to) inflatum, Chemnitz. (Impression of valve in matrix.)

Lima inflata, Chemnitz: Conchylien-Cabinet, vol. vii (1784), pl. lxviii, fig. 649.

Distribution.—Coll. Geol. Surv. Egypt: raised beach north of Kosseir (No. 2,151, Box No. 33*j*).

Family CARDITIDÆ.

Cardita calyculata, Linnæus.

Chama calyculata, Linnæus: Systema Naturæ, 10th ed. (1758), p. 692.

Distribution.—Beach deposits western border of Red Sea (Gray and Frembley). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*).

Cardita (Beguina) gubernaculum, Reeve.

Cardita gubernaculum, Reeve: Conchologia Iconica, vol. i (1843), pl. ii, fig. 9.

Distribution. — Beach deposits of Red Sea (Issel, Gray & Frembley); Red Sea (Issel); Aden, Zanzibar, and Madagascar (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*; Nos. 2,090–2,105, Box No. 20*j*); 50 foot beach at Gemsah (Nos. 2,031–2,057, Box No. 58*j*); young form from raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*).

Venericardia Cumingi, Deshayes.

Cardita Cumingi, Deshayes: Proc. Zool. Soc. London, 1852, p. 102, pl. xvii, fig. 15.

Distribution.—Aden (B.M.); Aden and Borneo (E. A. Smith). Coll. Geol. Surv. Egypt: 50 foot beach at Gemsah (Nos. 2,031–2,057, Box No. 58*j*).

Family ARCTICIDÆ (=CYPRINIDÆ).

Libitina oblonga, Linnæus.

Chama oblonga, Linnæus: Systema Naturæ, 10th ed. (1758), p. 692 (=*Guinaica*, Lamarck).

DISTRIBUTION.—Beach deposits of the Red Sea (Issel); Andaman Islands and Polynesia (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,090–2,105, Box No. 20*j*); raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (Nos. 1,646, 1,647, Box No. 76*j*).

Family LUCINIDÆ.

Loripes globosa, Forskal.

Venus globosa, Forskal: Desc. Animalium, 1775, No. 53, p. 122.

DISTRIBUTION.—Beach deposits western border of Red Sea (Gray and Frembley); Gulfs of Akaba and Suez (Issel); Red Sea (B.M.). Coll. Geol. Surv. Egypt: beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*).

Codakia exasperata, Reeve. (Pl. XXI, Fig. 4.)

Lucina exasperata, Reeve: Conchologia Iconica, vol. vi (1850), pl. i, fig. 4.

DISTRIBUTION.—Honduras (Reeve—this locality is doubted by Mr. E. A. Smith); North Australia, Aden, Red Sea, etc. (E. A. Smith). Coll. Geol. Surv. Egypt: beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*); raised beach 80 feet above sea, Camp 6, Wadi Gueh (No. 1,645, Box No. 57*k*; No. 1,584, Box No. 23*k*; No. 1,557, Box No. 25*k*); raised beach, Camp 6, Wadi Gueh (No. 1,574, etc., Box No. 62*k*); raised beach north of Kosseir (No. 2,130, Box No. 45*j*; No. 2,111, Box No. 46*j*; Nos. 2,121–2138, Box No. 50*j*); raised beach 300 feet above sea, Camp 5, Wadi Hamrawen (No. 1,553, Box No. 18*k*).

Codakia fibula, Reeve.

Lucina fibula, Reeve: Conchologia Iconica, vol. vi (1850), pl. vii, fig. 33.

DISTRIBUTION.—Red Sea (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea, Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*); raised beach 80 feet above sea, Camp 6, Wadi Gueh (No. 1,557, Box No. 25*k*).

Family TELLINIDÆ.

Tellina remies, Linnæus.

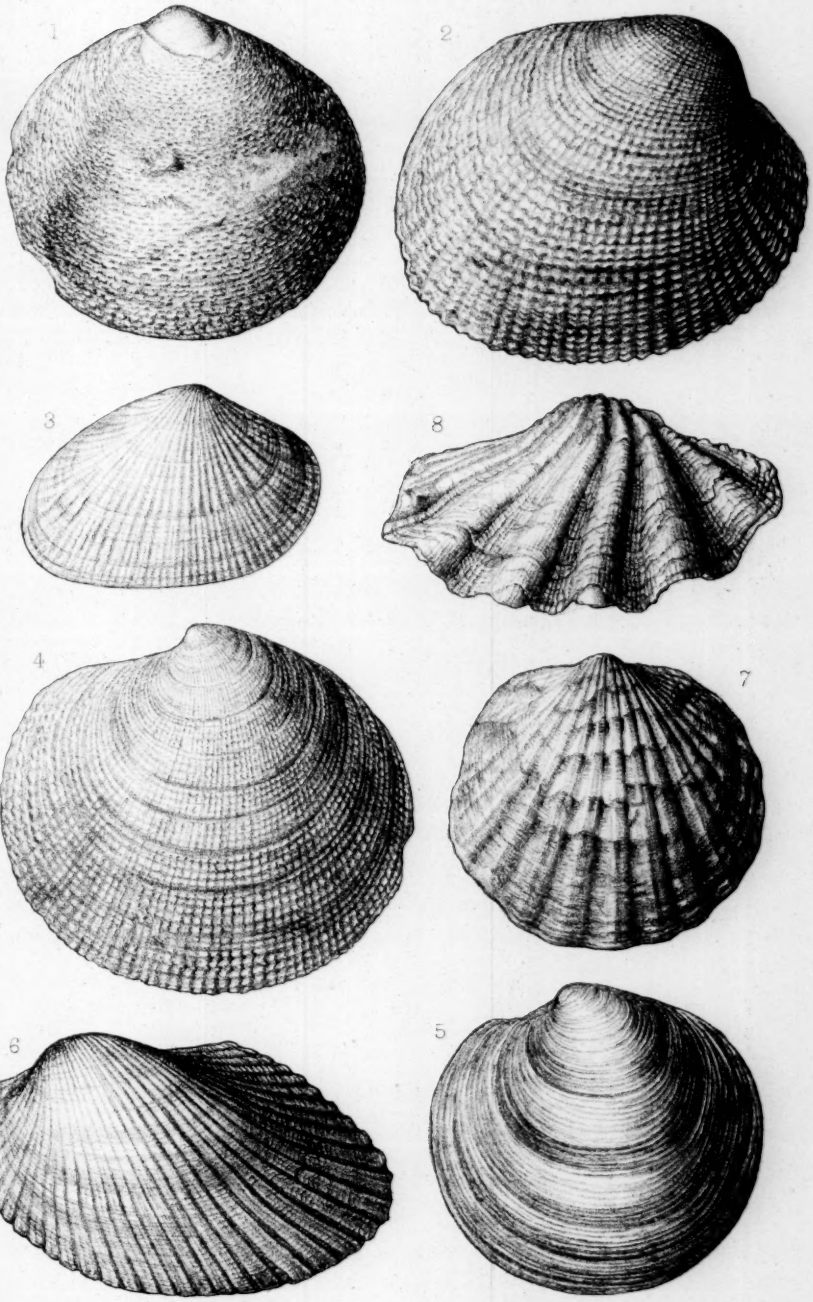
Tellina remies, Linnæus: Systema Naturæ, 10th ed. (1758), p. 676.

DISTRIBUTION.—Australia (B.M.). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (No. 1,645, Box No. 75*j*).

Tellina rugosa, Born.

Tellina rugosa, Born: Testacea Mus. Cæsarei Vindobonensis, 1780, pl. ii, figs. 3, 4.

DISTRIBUTION.—Beach deposits on the western shore of Red Sea (Gray & Frembley); New Caledonia, etc. (B.M.). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (Nos. 1,646, 1,647, Box No. 76*j*); raised



G.M.Woodward del. et lith. West, Newman imp.

Modern Shells from Red Sea Beach deposits

beach, Camp 6, Wadi Gueh (No. 1,600, Box No. 57*k*; Nos. 1,574, etc., Box No. 62*k*).

Tellina (Tellinella) sulcata, Wood.

Tellina sulcata, W. Wood: General Conchology, 1815, p. 178, pl. xlvii, fig. 1.

Distribution.—Red Sea, Aden, Philippines (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach, Camp 6, Wadi Gueh (Nos. 1,574, etc., Box No. 62*k*).

Eutellina (Peronea = Psammotella) rosea, Gmelin.

Tellina rosea, Gmelin: Systema Naturæ, 13th ed. (1790), p. 3,238.

Distribution. — Red Sea (B.M.). Coll. Geol. Surv. Egypt: Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); 50 foot beach at Gemsah (Nos. 2,031–2,057, Box No. 58*j*); an abnormal form from beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*).

Arcopagia scobinata, Linnæus. (Pl. XXI, Fig. 1.)

Tellina scobinata, Linnæus: Systema Naturæ, 10th ed. (1758), p. 678.

Distribution.—Isle of Réunion; Gulf of Akaba (Issel). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 6, Wadi Gueh (No. 1,584, Box No. 23*k*).

Family DONACIDÆ.

Donax trifasciatus, Reeve.

Donax trifasciatus, Reeve: Conchologia Iconica, vol. viii (1854), pl. ii, fig. 7.

Distribution.—Philippines (B.M.). Coll. Geol. Surv. Egypt: beach against old island west of Camp 51, south of Gharib lighthouse (Nos. 2,021–2,030, Box No. 57*j*).

Family MACTRIDÆ.

Mactra olorina, Philippi.

Mactra olorina, Philippi: Abbild. und Besch. Conchylien, vol. ii (1847), p. 72, pl. ii, fig. 2.

Distribution.—Gulf of Suez and in the Red Sea beach deposits (Issel). Coll. Geol. Surv. Egypt: Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*).

Family VENERIDÆ.

Venus reticulata, Linnæus. (Pl. XXI, Fig. 2.)

Venus reticulata, Linnæus: Systema Naturæ, 10th ed. (1758), p. 687.

Distribution. — Red Sea beach deposits (Gray & Frembley); Gulf of Akaba, Madagascar, Philippines, Society Islands, and the Red Sea beach deposits (Issel); Red Sea, Aden, Persian Gulf, Indian Ocean, etc. (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 6, north of Wadi Gueh (No. 1,648, Box Nos. 3*j* and 77*j*; No. 1,563, Box No. 26*k*); Recent beach between Jebel Mellaha and Jebel Zeit (No. 2,168, Box No. 6*j*); raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,090–2,105, Box No. 20*j*); raised beach No. 2, west of Kosseir, 520 feet above sea (No. 1,579, Box No. 13*k*); raised beach 300 feet above sea, Camp 5, Wadi Hamrawen (No. 1,553, Box No. 18*k*); raised

beach, hill north-west of Camp 7, Wadi Abu Shigeleh, 560 feet above sea (No. 1,627, Box No. 19*k*).

Chione costellifera, Adams & Reeve.

Venus costellifera, Adams & Reeve: Zool. Voy. "Samarang," 1848, p. 79, pl. xxi, fig. 18.

Distribution—Philippines (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*).

Callista florida, Lamarck.

Venus florida, Lamarck: Hist. Nat. Anim. sans Vert., vol. v (1818), p. 602.

Distribution. — Suez, Madagascar, Mozambique, Pacific Ocean, New Holland, and Red Sea beach deposits (Issel); Red Sea, Aden, Persian Gulf, Mozambique, Madagascar, Seychelles (E. A. Smith). Coll. Geol. Surv. Egypt: Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*).

Callista (like) **costata**, Chemnitz.

Venus costata, Chemnitz: Conchylien-Cabinet, vol. xi (1795), p. 226, pl. ccii, fig. 1,975.

Distribution. — Philippines (B.M.). Coll. Geol. Surv. Egypt: raised beach north of Kosseir (No. 2,111, Box No. 46*j*); beach No. 2, north-west of Camp 40, plain east of Jebel Mellaha, east of Red Sea Hills (No. 2,258, Box No. 29*h*).

Circe æquivoca, Chemnitz.

Venus æquivoca, Chemnitz: Conchylien-Cabinet, vol. xi (1795), p. 229, pl. ccii, fig. 1,980.

Distribution.—Philippines (B.M.). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 6, Wadi Gueh (No. 1,557, Box No. 25*k*).

Circe corrugata, Chemnitz.

Venus corrugata plana, Chemnitz: Conchylien-Cabinet, vol. vii (1784), p. 25, pl. xxxix, figs. 410, 411.

Distribution.—Suez (Issel); Red Sea, Persian Gulf, Aden, Madagascar, New Holland (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach 80 feet above sea, Camp 6, Wadi Gueh (No. 1,557, Box No. 25*k*).

Circe callipygia, Born.

Venus callipygia, Born: Testacea Mus. Cæsarei Vindobonensis, 1780, p. 68, pl. v, fig. 1.

Distribution.—Gulf of Akaba, Red Sea, and beach deposits of Red Sea (Issel); Red Sea and Aden (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*).

Circe (Lioconcha) lentiginosa, Chemnitz.

Venus lentiginosa, Chemnitz: Conchylien-Cabinet, vol. xi (1795), p. 223, pl. cci, figs. 1,963, 1,964.

Distribution.—Red Sea and beach deposits of Red Sea (Issel); Red Sea and Madagascar (B.M.). Coll. Geol. Surv. Egypt: Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); beach against old island west of Camp 51, south of Gharib lighthouse

(Nos. 2,021–2,030, Box No. 57*j*); raised beach 80 feet above sea, Camp 6, Wadi Gueh (No. 1,610, Box No. 27*k*).

Circe (Crista) pectinata, Linnæus. (Pl. XXI, Fig. 3.)

Venus pectinata, Linnæus: Systema Naturæ, 10th ed. (1758), p. 689 (= *Cytherea Savignyi*, Jonas).

Distribution.—Suez and Red Sea beach deposits (Issel); Red Sea, Indian Ocean, Aden, Moluccas, etc. (E. A. Smith). Coll. Geol. Surv. Egypt: plain between Ras Gemsah and Jebel Zeit (No. 2,224, Box No. 12*j*); beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*); Recent beach between Jebel Mellaha and Jebel Zeit (Nos. 2,162–2,167, Box No. 21*j*); Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); beach against old island west of Camp 51, south of Gharib lighthouse (Nos. 2,021–2,030, Box No. 57*j*); raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*).

Tapes virgineus, Linnæus.

Venus virginea, Linnæus: Systema Naturæ, 12th ed. (1767), vol. i, pt. 2, p. 1,136.

Distribution.—Aden, New Holland, China Sea (E. A. Smith). Coll. Geol. Surv. Egypt: Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*).

Sunetta effossus, Hanley.

Cytherea effossa, Hanley: Proc. Zool. Soc. London, 1842, p. 123.

Distribution. — Philippines (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*).

Dosinia laminata, Reeve.

Artemis laminata, Reeve: Conchologia Iconica, vol. vi (1850), pl. vii, fig. 41.

Distribution. — Philippines (B.M.). Coll. Geol. Surv. Egypt: 50 foot beach at Gemsah (Nos. 2,031–2,057, Box No. 58*j*); raised beach east of Jebel Esh (Nos. 2,172–2,194, Box No. 64*j*).

Dosinia radiata, Reeve. (Pl. XXI, Fig. 5.)

Artemis radiata, Reeve: Conchologia Iconica, vol. vi (1850), pl. vii, fig. 37.

Distribution.—Bay of Suez (Issel). Coll. Geol. Surv. Egypt: plain between Ras Gemsah and Jebel Zeit (No. 2,222, Box No. 8*j*); Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*); raised beach 300 feet above sea, Camp 5, Wadi Hamrawen (No. 1,553, Box No. 18*k*); beach No. 2, north-west of Camp 40, plain east of Jebel Mellaha, east of Red Sea Hills (No. 2,257, Box No. 29*h*).

Family CARDIIDÆ.

Cardium leucostoma, Born.

Cardium leucostoma, Born: Testacea Mus. Cæsarei Vindobonensis, 1780, pl. iii, figs. 6, 7.

Distribution.—Indian Ocean (B.M.). Coll. Geol. Surv. Egypt: Recent beach south of Gharib lighthouse (No. 2,198–2,216, Box No. 53*j*); a cast allied to this species from beach No. 2, north-west of Camp 40, plain east of Jebel Mellaha, east of Red Sea Hills

(No. 2,257, Box No. 27*h*); cast of probably this species from raised beach, hill north-west of Camp 7, Wadi Abu Shigeleh, 560 feet above sea (No. 1,627, Box No. 19*h*).

Cardium rubicundum, Reeve.

Cardium rubicundum, Reeve: Conchologia Iconica, vol. ii (1844), pl. ix, fig. 44 (= *C. magnum*, Chemnitz, *vide* Issel).

DISTRIBUTION. — Gulf of Suez (Issel); Aden, Zanzibar (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*).

Lævicardium (like) **oblongum**, Gmelin.

Cardium oblongum, Gmelin: Systema Naturæ, vol. i (1790), pt. 6, p. 3,254.

DISTRIBUTION. — Mediterranean (Gmelin). Coll. Geol. Surv. Egypt: beach No. 2, north-west of Camp 40, plain east of Jebel Mellaha, east of Red Sea Hills (No. 2,258, Box No. 29*h*).

Hemicardium (Opisocardium) auriculum, Forskal.

Cardium auriculum, Forskal: Desc. Animalium, 1775, No. 52, p. 122.

DISTRIBUTION.—Gulf of Akaba, Bay of Suez, and beach deposits of the Red Sea (Issel). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,090–2,105, Box No. 20*j*); Recent beach west of Jebel Zeit (No. 2,157, Box No. 72*j*).

Family TRIDACNIDÆ.

Tridacna gigas, Linnæus. (Young forms.) (Pl. XXI, Fig. 8.)

Tridacna gigas, Linnæus: Systema Naturæ, 10th ed. (1758), p. 691.

DISTRIBUTION.—Beach deposits near Kosseir (Fraas, B.M.). Coll. Geol. Surv. Egypt: Recent beach between Jebel Mellaha and Jebel Zeit (No. 2,161, Box No. 7*j*); Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*).

Family CHAMIDÆ.

Chama cornucopiæ, Reeve.

Chama cornucopia, Reeve: Conchologia Iconica, vol. iv (1846), pl. iv, fig. 22 (= *C. Corbierei*, Jonas, *vide* Issel).

DISTRIBUTION.—Beach deposits of the Red Sea (Issel); Gulf of Akaba and Suez (Issel); Red Sea (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,090–2,105, Box No. 20*j*); Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*).

Chama Jukesi, Reeve.

Chama Jukesi, Reeve: Conchologia Iconica, vol. iv (1847), pl. vii, fig. 39.

DISTRIBUTION.—Isle of Luzon, Philippines (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,058–2,098, Box No. 18*j*).

Chama nivalis, Reeve.

Chama nivalis, Reeve: Conchologia Iconica, vol. iv (1846), pl. iv, fig. 17.

DISTRIBUTION. — Australia (B.M.). Coll. Geol. Surv. Egypt: beach east of Gharib (Nos. 2,227–2,254, Box No. 17*j*); Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); 50 foot beach at Gemsah (No. 2,038, Box No. 62*j*); raised beach

east of Jebel Esh (Nos. 2,172–2,190, Box No. 64*j*; No. 2,179, Box No. 66*j*); raised beach 80 feet above sea, Camp 6, north of Wadi Gueh, west of Kosseir (Nos. 1,655–1,657, Box No. 81*j*); raised beach No. 2, west of Kosseir, 520 feet above sea (No. 1,581, Box No. 16*k*).

Family GARIDÆ (=PSAMMOBIIDÆ).

Asaphis deflorata, Linnæus.

Venus deflorata, Linnæus: Systema Naturæ, 10th ed. (1758), p. 687.

DISTRIBUTION. — Red Sea, Indian and Pacific Oceans, Aden (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,090–2,105, Box No. 20*j*).

Family MYIDÆ.

Lutraria intermedia (Deshayes MS.), Reeve.

Mesodesma intermedia, Reeve: Conchologia Iconica, vol. viii (1854), pl. iii, fig. 17.

DISTRIBUTION. — Zanzibar (B.M.). Coll. Geol. Surv. Egypt: Recent beach south of Gharib lighthouse (Nos. 2,198–2,216, Box No. 53*j*); 50 foot beach at Gemsah (No. 2,031, Box No. 59*j*).

Corbula cuneata, Hinds.

Corbula cuneata, Hinds: Proc. Zool. Soc. London, 1843, p. 55.

DISTRIBUTION.—Philippines (B.M.). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,090–2,105, Box No. 20*j*).

Corbula Taheitensis, Lamarck.

Corbula Taheitensis, Lamarck: Hist. Nat. Anim. sans Vert., vol. v (1818), p. 496.

DISTRIBUTION.—Tahiti, New Guinea, Philippines, Aden (E. A. Smith). Coll. Geol. Surv. Egypt: raised beach 20 feet above sea at Gharib lighthouse (Nos. 2,090–2,105, Box No. 20*j*); Ras Shokhair, west coast of the Gulf of Suez, north-east of Camp 50 (No. 2,267, Box No. 37*h*).

Family PHOLADIDÆ.

Martesia, sp.

DISTRIBUTION.—Coll. Geol. Surv. Egypt: Ras Shokhair, west coast of the Gulf of Suez, north-east of Camp 50 (No. 2,269, Box No. 39*h*).

LITERATURE.

Several papers have been written on the conchological fauna of the beach deposits of the Red Sea and other parts of Egypt, but as the subject is so interwoven with the history of the actual living forms of the Red Sea, the following list of titles is compiled so as to include the more important contributions dealing with both aspects of the subject.

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EXPLANATION OF PLATE XX.

FIG. 1.—*Turbo radiatus*, Gmelin. 20 feet above sea, Gharib lighthouse. Back view of medium-sized specimen.

FIG. 2.—*Canarium gibberulum*, Linnæus. Jebel Zeit. Back view of specimen with varicosed spire.

FIG. 3.—*Strombus fasciatus*, Born. Between Jebel Mellaha and Jebel Zeit. Specimen showing colour-markings and characteristic tuberculations at the shoulder.

FIG. 4.—*Clanculus Pharaonius*, Linnæus. 20 feet above sea, Gharib lighthouse. Specimen exhibiting the typical granulate ornamentation.

FIG. 5.—Basal view of same, with umbilicus surrounded by radial plicæ.

FIG. 6.—*Terebra duplicata*, Linnæus. Jebel Zeit. Front view of shell, showing the smooth, depressed ribbing of this species.

FIG. 7.—*Terebra maculata*, Linnæus. North of Ras Mohamed or Ghazlandi Bay. Front aspect of specimen, with original colour-bands.

FIG. 8.—*Conus nussatella*, Linnæus. East of Gharib. Specimen showing the closely-set, granulated striations of this species.

FIG. 9.—*Conus omaria*, Hwass. Wadi Gueh, Camp 6. A well-marked specimen, bearing the triangular white spots peculiar to this shell.

FIG. 10.—*Pleurotoma Garnonsi*, Reeve. 50 foot beach at Gemsah. Shell showing small brown spots on the raised spiral ribs.

FIG. 11.—*Chicoreus anguliferus*, Lamarck. South of Gharib lighthouse. Specimen exhibiting a prominent node between each of the varices.

FIG. 12.—*Vasum cornigerum*, Lamarck. 80 feet above sea, Camp 6, north of Wadi Gueh. A medium-sized specimen, showing the typical sculpture of this species.

EXPLANATION OF PLATE XXI.

FIG. 1.—*Arcopagia scobinata*, Linnæus. Northern Wadi Gueh, Camp 6, 80 feet above sea. Exterior of right valve, showing the rasp-like character of the ornamentation.

FIG. 2.—*Venus reticulata*, Linnæus. 80 feet above sea, Camp 6, north of Wadi Gueh. Exterior of a right valve.

FIG. 3.—*Circe pectinata*, Linnæus. South of Gharib lighthouse. Medium-sized example, showing characteristic sculpture.

FIG. 4.—*Codakia exasperata*, Reeve. 80 feet above sea, Camp 6, north of Wadi Gueh. External view of a left valve.

FIG. 5.—*Dosinia radiata*, Reeve. South of Gharib lighthouse. External view of a left valve, showing strong concentric striations and the growth periods of the shell.

FIG. 6.—*Anadara antiquata*, Linnæus. Camp 6, Wadi Gueh. External surface of left valve.

FIG. 7.—*Glycymeris pectunculus*, Linnæus. Big Bay, south of Sherm, Sinai. Exterior of valve, showing striped colouring.

FIG. 8.—*Tridacna gigas*, Linnæus. Between Jebel Mellaha and Jebel Zeit. External view of a left valve belonging to a small example of this species.

EXPLANATION OF PLATE XXII.

FIG. 1.—*Capiluna Ruppelli*, var. *Barroni* (var. nov.). Ras Gharib. Front view of specimen, showing the elongate perforation.
FIG. 2.—Lateral aspect of same specimen.
FIG. 3.—Internal view of same shell, showing a nearly circular basal margin.
FIG. 4.—Details of external sculpture, magnified.
FIG. 5.—*Alectryonia*, allied to *crista-galli*, Linnæus. North of Kosseir. Fractured view of specimen, with parts of both valves attached, exposing the ligamental area.
FIG. 6.—Another aspect of the same shell.
FIG. 7.—*Pecten Vasseli*, Fuchs. Northern Wadi Gueh, Camp 6, 240 feet above sea. External view of a lower valve.
FIG. 8.—*Pecten Vasseli*, Fuchs. Upper coral terrace between Nebk and Sherm, S.E. Sinai. External view of an upper valve belonging to another specimen.
FIG. 9.—*Pecten Vasseli*, Fuchs. Magnification of external sculpture.
FIG. 10.—*Chlamys Reissi*, Bronn. North of Kosseir. External view of a left valve with numerous ribs ornamented by thin, transverse, elevated striæ.

(Except where otherwise mentioned, the figures on all the Plates are drawn natural size.)

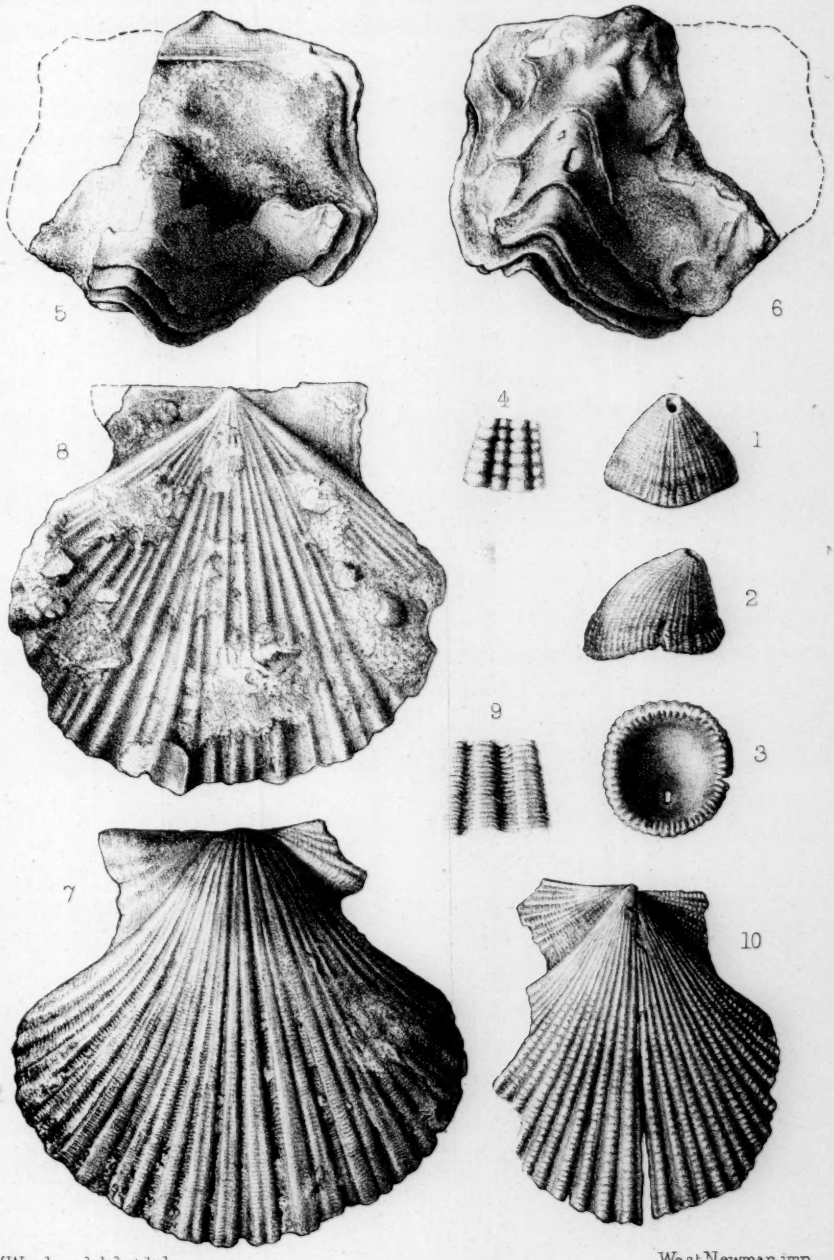
VI.—NOTE ON *EPHIPPIOCERAS CLITELLARIUM*, J. DE C. SOWERBY, SP., AND *E. COSTATUM*, A. H. FOORD.

By G. C. CRICK, F.G.S., of the British Museum (Natural History).

THE name *Nautilus clitellarius* was given by J. de C. Sowerby[1] to a Nautiloid from the Coal-measures, Coalbrookdale, Shropshire, and the description was accompanied by three figures, each representing a different specimen. In 1884[2] the species was included by Professor Hyatt in his new genus *Ephippioceras*. In 1891 Dr. A. H. Foord[3] found a new species, *Ephippioceras costatum*, which was said to be "distinguished from *E. clitellarium* (to which it is, however, very closely related) by the character of the septa and by the surface ornaments. The septa in *E. costatum* do not form such an acute lobe upon the periphery as do those of *E. clitellarium*, and they are also a little wider apart in the former species than they are in the latter. Moreover, *E. costatum* is provided with prominent transverse costæ, which are strongest upon the sides of the shell where they swell out into heavy folds. These costæ are directed obliquely backwards, and cross the septa at an acute angle, passing across the periphery and forming a shallow sinus in the middle. None of the specimens in the British Museum have the test preserved, so that the ribbing has only been observed upon casts. The costæ are equally well developed upon the body-chamber and upon the septate part of the shell in the adult, but they were either very feeble or altogether absent in the young." A re-examination of the specimens in the Museum collection shows that the separation of the two forms is quite justifiable.

Since Dr. Foord's species was instituted the British Museum collection has been enriched by the addition of two of Sowerby's figured specimens, viz., the originals of his figs. 5*a* and 5*b*.

[1] Trans. Geol. Soc., vol. v, pt. 3 (1840), expl. of plates, etc., pl. xl, figs. 5, 5*a*, *b*.
[2] Proc. Boston Soc. Nat. Hist., vol. xxii (1884), p. 290.
[3] Cat. Foss. Ceph. Brit. Mus., vol. ii (1891), p. 103.



G.M.Woodward del. et lith. West, Newman imp.

Extinct Shells from Red Sea Beach Deposits.

Sowerby's description of his species is as follows :—

"Globose, umbilicated, septa numerous, much bent in the middle, truncated and not recurved at the ends; siphuncle central; umbilicus small; aperture above twice as wide as long.

"The length of the aperture is $1\frac{1}{2}$ inch, the width $2\frac{3}{4}$ inches."

In regard to the angle of the septa on the ventral or peripheral area, the presence of obscure coarse costæ, and the general form of the shell, the original of Sowerby's fig. 5*a* agrees exactly with the type of Foord's *E. costatum*; the costæ appear to be almost wanting on the earlier portion of the outer whorl, but the fossil is here somewhat imperfectly preserved.

The specimen represented in Sowerby's fig. 5*b* is a fragment of an apparently smooth shell, the septa of which form an angle on the ventral or peripheral area corresponding almost exactly to that in the specimen figured by Dr. Foord as *E. clitellarium*. It appears, however, to have belonged to a rather more rapidly expanding shell with slightly more depressed whorls than the fossil which Dr. Foord has figured and referred to that species; in fact, in these respects it agrees better with the earlier portion of the outer whorl of the original of Sowerby's fig. 5*a*. Still, the form of the septa and the apparent smoothness of the shell lead us to regard the specimen as specifically identical with the example figured by Dr. Foord as *E. clitellarium*, J. de C. Sowerby, sp.

As we have not seen the original of Sowerby's fig. 5, we can make no observations on that specimen.

From the foregoing remarks it will be seen that the specimens figured by Sowerby probably belong to at least two distinct species; the original of his fig. 5*b* agreeing with Foord's interpretation of *E. clitellarium*, whilst the specimen represented in his fig. 5*a* is specifically identical with Foord's *E. costatum*. It would then be of great interest to know where the fossil represented in Sowerby's fig. 5 is, and to learn whether its characters correspond to those of the original of that author's fig. 5*b*, or to those of the example depicted in his fig. 5*a*, for if it be specifically distinct from the fossil represented in his fig. 5*a* (= *E. costatum*, Foord), we think it should, owing to the fragmentary nature of the original of his fig. 5*b*, be regarded as the type of Sowerby's species (*E. clitellarium*).

VII.—Note on Zieten's Type-Specimens of *Ammonites polygonius* and *Ammonites discoides*.

By G. C. Crick, F.G.S., of the British Museum (Natural History).

THE presence of Zieten's type-specimen of *Ammonites calcar*[1] in the British Museum (Natural History) among some fossils which were bought of Dr. Bruckmann naturally suggested an examination of the other fossil Cephalopoda obtained from the same source, in the hope of finding other type-specimens. Thus far, the result of this examination has been the discovery of two more

[1] See Geol. Mag., December, 1899, p. 554.

of Zieten's types; these are the type-specimens of (i) *Ammonites polygonius* and (ii) *Ammonites discoides*.[1]

(i) *Ammonites polygonius*, C. H. v. Zieten, Verstein. Württembergs, Heft iii (1831), p. 21, pl. xv, figs. 6*a*, *b*, *c*. This specimen [register number 39,699] is labelled in Dr. Bruckmann's handwriting as follows: "*Ammonites pustulatus Suevicus*, Quenst. (*Amm. polygonius*, Ziet.) Selten. Brauner Jura ζ (Ornatenthon), Gammelshausen"; and on the label there has been written in pencil the letters "[Dr. O.]," signifying "Dr. Oppel," as I have been able to ascertain from other labels in this Museum that are also in Dr. Bruckmann's handwriting. The specimen agrees so well in size, form, and colour with Zieten's figure (except that the latter is reversed), that there cannot be any doubt whatever about its being the type-specimen, the imperfection of the anterior part of the fossil being accurately represented in Zieten's fig. 6*a*. The periphery, however, is not so sharp as Zieten's fig. 6*b* indicates, but is slightly truncated[2] owing to the absence of the keel. The specimen is entirely septate, but the suture-line is only imperfectly displayed; its complete course cannot be traced.

Zieten described the species as follows:—"Rücken scharf, die sehr dicken, der Länge nach feingestreiften Windungen bilden einen tiefen Nabel, welcher mit spitzigen Knötchen umgeben ist. Rippen theils einfach, theils gegabelt. Nach dem vieleckigen Durchschnitt seiner Windungen benannt. Verkiest im Lias-Schiefer von Zell, unweit Boll."

["Back (periphery) sharp; the very thick longitudinally finely-striated whorls form a deep umbilicus, which is surrounded by pointed tubercles. Ribs sometimes simple, sometimes bifurcated. Named after the polygonal shape of the cross-section of its whorls. Pyritized in the Lias shales of Zell, not far from Boll."]

From the above remarks it will be seen that Zieten's statement as to the horizon and locality does not agree with the label which now accompanies the specimen, for the fossil is labelled "Brauner Jura ζ (Ornatenthon), Gammelshausen," which is a short distance south-east of Boll, in Württemberg, whilst Zieten states that the species occurred in the "Lias-Schiefer von Zell," i.e., a little to the north-east of Boll. According to Oppel ("Juraformation," p. 560), the species occurs pyritized in the "Zone of *Ammonites anceps*" [=the Brauner Jura ζ in part] at Oberlenningen and Gammelshausen, near Boll; and Quenstedt, in his work on "Die Ammoniten des schwäbischen Jura" (Bd. ii, Heft 14–15, 1887, p. 755, tab. lxxxvi, fig. 10), describes and figures the species, under the name *Ammonites pustulatus suevicus*, from the Brauner Jura ζ of Gammelshausen. It is most probable, then, that the specimen is accurately labelled; for it is quite evident that some other species which Zieten attributed to the Lias are certainly not of Liassic age.

It may be mentioned that this species has been referred[3] to Denys

[1] Briefly alluded to in Geol. Mag., December, 1899, p. 556, note 1.

[2] See F. A. Quenstedt's "Die Ammoniten des schwäbischen Jura," Bd. ii, Heft 14–15 (1887), tab. lxxxvi, fig. 10.

[3] See Waagen's "Jurassic Fauna of Kutch," vol. i (Cephalopoda), 1873, p. 41.

de Montfort's genus *Amaltheus*, but Parona and Bonarelli[1] include it in the genus *Lophoceras* instituted by them in 1897.

(ii) *Ammonites discoides*, C. H. v. Zieten, Verstein. Württembergs, Heft iii (1831), p. 21, pl. xvi, figs. 1*a*, *b*, *c*. This specimen [register number 62,568] is accompanied by a label in Dr. Bruckmann's handwriting to the following effect: "From Zieten's collection. *Ammonites capellinus jurensis*, Quenst. (*Amm. discoides*, Ziet., T. 16, F. 1). Selten. Jurensismergel. Heiningen in Württemberg"; and on the label there has been written in pencil the letters "[Dr. O.]," signifying "Dr. Oppel." Its size, general form, and colour agree so well with Zieten's figure (except that the latter is reversed), that there can be no doubt whatever as to its identity. At about the commencement of the last third of the outer whorl a small piece is broken away at the periphery, and although this imperfection is not figured, yet the shape of the anterior portion of the specimen is so accurately represented in Zieten's figure that there cannot possibly be any doubt as to the identification of the specimen.

Zieten's description is as follows:—"Rücken sehr scharf, die inneren Windungen stark bedeckt, Rippen sichelförmig, welche auf der scharfen Rückenkante in spitzigen Winkeln zusammenlaufen. In der Hauptform dem *Ammonites discus* (Sow.), ähnlich. Aus dem Lias-Sandstein von Reichenbach im Thal."

["Back (periphery) very sharp, the inner whorls strongly ornamented, ribs falciform and meeting on the sharp periphery in acute angles. In general form similar to *Ammonites discus*, Sowerby. From the Lias sandstone of Reichenbach in the Valley."]

In this case also there seems to be a discrepancy between the label and Zieten's statement as to the locality of the fossil; Heiningen, the locality given on the label, being about three miles south of Göppingen, whilst "Reichenbach im Thal," the locality given by Zieten, is north of Donzdorf and almost due east of Göppingen. Quenstedt, in his work on "Die Ammoniten des schwäbischen Jura" (Bd. i, Heft 8–9, 1885, pp. 416–7, tab. liii, figs. 1 and 3), records the species from the *Jurensis*-beds at both places.

It may be remarked that this species was placed by Hyatt[2] in his

[1] Mém. Acad. Sci., etc., Savoie, sér. iv, vol. vi (1897), p. 122.

[2] A. Hyatt: Bull. Mus. Comp. Zoöl., vol. i, No. 5, p. 102. The whole volume, consisting of Nos. 1–13, is dated 1863–9; No. 4 was published in June, 1865, and No. 6 is dated December 26, 1867, but the copies of No. 5 that I have seen are not dated. This number, however, was published towards the end of December, 1867. For this date I am indebted to Mr. S. S. Buckman, who tells me that he has a copy of Prof. Hyatt's paper bearing a date-slip, of which the following is an exact copy:—

Boston Society of Natural History.
March 23, 1868.

[Extract from Records of Jan. 3, 1868.]

"Mr. A. Hyatt laid upon the table No. 5 of the Bulletin of the Museum of Comparative Zoölogy, published about a week since, but accidentally bearing no date of publication," etc.

S. H. Scudder,
Sec. Boston Soc. Nat. Hist.

Please attach this to the copy of the Bulletin sent to you.
A. Hyatt.

genus *Lioceras*,[1] but Buckman[2] has made it the type of a new genus, *Polyplectus*. The Museum, then, is fortunate in possessing this type-specimen, for it is not only the type of Zieten's species *Amm. discoides*, but also the type of Buckman's genus *Polyplectus*.

NOTICES OF MEMOIRS.

I.—The Basal (Carboniferous) Conglomerate of Ullswater and its Mode of Origin. By R. D. Oldham, Geological Survey of India.[3]

On the western shore of Ullswater, near its lower end, a good section has recently been exposed of the basal conglomerates variously ascribed to Old Red or lowermost Carboniferous age. This conglomerate has been considered as glacial in its origin, but does not appear to the author to present any true glacial characteristics. It contains angular and subangular blocks of all sizes, which are not scattered indiscriminately, but are arranged with a distinct, though obscure, banding. In the admixture of blocks of all sizes and the absence of rounded boulders, it differs from the known river deposits of temperate climes, and more closely resembles the accumulations of débris which result from cloud-bursts than any other form of deposit which can be observed in the British Isles at the present day. The conglomerate cannot, however, be reasonably attributed to any such local deposits; its true analogue must be looked for in the dry regions of Western and Central Asia, where all rainfall rushes off the bare hills, producing an effect very like that of a cloud-burst in our own climate, and causing a mixed mass of water, silt, and stones to rush down the river channels, which are dry or carrying only a feeble stream in ordinary times. This mass of material is carried out from the hills, and forms a deposit with a gently sloping surface extending for miles into the open country. Carried along in this manner the rock-fragments do not undergo the rounding which they suffer in a more permanent torrent, and are deposited, on the sudden subsidence of the flood, in a mixed mass of fragments of all sizes. The sections exposed along the roadside near the foot of Ullswater not only exhibit a rude trending, due to the action of successive floods, but also show patches of current-bedded, fine-grained, gravelly material, representing the action of the feebler stream which continued after the passage of the flood.

The conclusion drawn is that the conglomerate is a torrential deposit, formed on dry land, near the foot of a range of hills, in a generally dry climate, varied by seasonal or periodical bursts of rain. The red colour of the fine-grained material suggests tropical or sub-tropical conditions, as the formation of red soils is at the present day so much more common in tropical than in temperate regions that it may almost be regarded as a characteristic of a hot climate.

[1] Originally spelt *Leioceras*.

[2] S. S. Buckman: Inf. Oo. Amm. (Mon. Pal. Soc.), pt. iv (1890), p. 214.

[3] Read before the British Association, Section C (Geology), Bradford, Sept., 1900.

II.—The Influence of the Winds upon Climate during Past Epochs: a Meteorological Explanation of some Geological Problems. By F. W. Harmer, F.G.S.[1] (Abstract.)

THIS paper is a summary of a communication the author hopes to make to the Geological Society of London during the present winter, and is in continuation of one read at Dover in 1899, on "The Meteorological Conditions of North-Western Europe during the Pliocene and Glacial Periods."

The irregular distribution of the isotherms in the northern hemisphere is largely due to the direction of the prevalent winds. In regions where these are constantly varying, as, for example, in Great Britain, the climate varies diurnally, one day being often dry or cold and the next rainy or warm. In others, where the wind changes seasonally, one part of the year is rainless and another pluvial. Permanent alterations in climate would equally result were the course of the prevalent winds permanently changed.

The direction of the winds, which must always be more or less parallel to the isobars, depends on the relative position, and on the form and alignment of areas of high and low barometric pressure. The movements of the latter being largely interdependent, any important meteorological disturbance, however caused, may make its influence felt at a considerable distance from the focus of its origin.

The winds blow round areas of high and low pressure; outwards, from the former, and to the north of the Equator, from left to right; and inwards, towards the latter, from right to left. Hence, in the northern hemisphere, southerly winds prevail to the east of a cyclonic centre, and northerly winds to the west of it, the contrast between the temperature of the two areas being usually in proportion to the distance the aerial currents may have travelled from the south and the north respectively. Warm and cold winds must therefore necessarily coexist, causing differences in climate in countries having the same latitude. The winter temperature of Hudson's Bay is, for example, 60° F. colder than that of Great Britain. Similar climatal conditions must have also existed during the Pleistocene epoch.

The continental regions of the northern hemisphere, being at present warmer during summer than the ocean, are cyclonic; in winter they are colder, and consequently anticyclonic. Over the great ice-sheets of the Glacial Period, however, high pressure must have prevailed, more or less, at all seasons, and, generally, the meteorological conditions, including the direction of the prevalent winds, and local variations in climate must then have been widely different from those of our own times. Oceanic winds, with copious rainfall, may have prevailed in regions now arid, and mild winters where they are now excessively severe. Such cases of anomalous climate as those of the pluvial conditions of the Sahara, and of Arabia and Persia, during the Pleistocene era, may be satisfactorily explained by the changes in the relative positions of cyclonic and anticyclonic systems which were caused by the gradual growth and

[1] Read before the British Association, Section C (Geology), Bradford, Sept., 1900.

disappearance of the great ice-sheets, as may be the alternate humidity and desiccation of the great basin of Nevada, the former existence of the mammoth on the shores of the Polar Sea, etc.

It is difficult, however, to restore hypothetically the meteorological conditions of the Pleistocene epoch, on the theory that the maximum glaciation of the eastern and western continents was contemporaneous. At present the influence of the Gulf Stream, and the south-west winds caused by the Icelandic cyclone, carries in winter a comparatively warm climate, and low pressures, northwards into the Arctic Circle, but no permanent ice-sheet could have existed in Great Britain under such circumstances. Cyclones and anticyclones in regions more or less contiguous are, however, necessarily complementary, in order that the vertical circulation of the atmosphere may be maintained. The existence of an enormous polar anticyclone, extending southwards over a great portion of Europe and North America, would have involved also that of a cyclonic system of corresponding importance in the North Atlantic, a region which must have been at all seasons warmer than those covered with ice; but this would have caused south-west winds over Great Britain, and have prevented the permanent existence of an ice-sheet in these islands. If Europe and North America had been glaciated at the same time, which for the reasons given, however, seems improbable, the Icelandic cyclone, which now lies (statistically) in winter near to the south-east coast of Greenland, would have been forced to the south; but the further south it went the warmer would have been the southerly winds which blew east of its centre towards Great Britain and Western Europe. Conditions similar to those which may have prevailed during the maximum glaciation of North America occurred during the early part of 1899—for information as to which the author desires to acknowledge his indebtedness to Mr. W. N. Shaw, F.R.S., of the Meteorological Office. At that time a great low-pressure system, which sometimes extended from Europe to America, and from Iceland to the Canary Islands, occupied the North Atlantic. Vast volumes of cold air from the Arctic regions were consequently poured over North America, while Western Europe was flooded by warm aerial currents from the sub-tropical zone. At the beginning of February temperatures of from $-40°$ F. to $-60°$ F. were commonly registered in different parts of North America; at the same time the thermometer rose in London to 66° F., in Liége to 70° F., and in Davos, more than 5,000 feet above the sea, to 62° F., the average maximum for that month at the latter place being 38° F. For some weeks storms of exceptional violence occurred almost daily in the Atlantic. These coincident phenomena are directly traceable to the same cause.

No meteorological difficulties arise if we adopt the hypothesis that glacial and interglacial periods alternated in the eastern and western continents. If the ice-cap extended from Greenland to Scandinavia, the North Atlantic cyclone would have been forced to the south-west, towards the American coast, producing warm south-east winds over Labrador; if, on the contrary, it stretched from Greenland to North

America, the cyclone would have been driven in the direction of Europe, causing mild weather in the latter, as in the case just given.

Such a view affords a simpler explanation of the geological facts than those usually adopted. Instead of supposing that the climatic changes of the Great Ice Age, several times recurrent at intervals of a few thousand years only, were due to astronomical causes, it is here suggested that the climate of the Pleistocene epoch being uniformly colder than that of our own era, conditions of comparative warmth or cold may have been local, as they now are, affecting the great continental areas at different periods.

REVIEWS.

I.—Studies in Fossil Botany. By Dukinfield Henry Scott, M.A., Ph.D., F.R.S., F.G.S., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew. pp. xiii, 553, with 151 illustrations. (London: A. & C. Black, 1900.)

AS the title of Dr. Scott's work implies, "Studies in Fossil Botany" is not a 'textbook' in the ordinary acceptation of the term, giving a systematic course of the entire range of fossil plants, but contains thirteen lectures devoted to the microscopical structure, morphology, and affinities of Carboniferous plants, and one on the Mesozoic Gymnosperms. The groups studied are not chosen at random, but follow each other in natural sequence.

Lectures i–iii are devoted to the Equisetales. The *Calamites* are first described, and here, as in the subsequent groups, a description of the external characters of the group is given. These descriptions, however, take a subordinate place to the description of the internal organization of the plants, which forms the main subject of the lectures. The development of the young Calamite is traced through its early stages, and the different structures which go to make up the complete plant are described in detail. One of the important results of Dr. Scott's examination of the *Calamites* is to prove that the carinal canals of *Equisetum* and *Calamites* are homologous, both resulting from the rupture of the primary wood. After the description of *Arthropitys*, the common English form of Calamite, the two other types of Calamite stem structure, *Arthrodendron* and *Calamodendron*, are considered. The Calamite fructifications, *Calamostachys*, *Palæostachya*, and *Cingularia*, are then dealt with and their morphology discussed; then follow notes on *Archæocalamites* and *Macrostachya*.

In Lecture iv the *Sphenophyllales* are considered. In this group are placed the two genera *Sphenophyllum* and *Cheirostrobus*. This is a specially interesting chapter, dealing with types of plant structure which disappeared with Carboniferous times. Fortunately, the structure of stems, roots, leaves, and fructification of *Sphenophyllum* is known. The two British species showing structure—*S. plurifoliatum*, from the Lower Coal-measures, and *S. insigne*, from the Calciferous Sandstone series—are fully described. *Sphenophyllum*

Dawsoni is taken as the type of *Sphenophyllum* fructification, and is fully described. It might be remarked here, that *S. Dawsoni* is almost certainly the fruit of *S. cuneifolium*, Sternb., sp., of which probably *S. plurifoliatum* is the stem. The fructifications of other species of *Sphenophyllum* are described or referred to, and though the vegetative organs of all the species of *Sphenophyllum* have a great similarity, the arrangement of the sporangia in some of the species varies considerably: so much is this the case, that the genus as presently employed must be regarded more in the light of a group than a genus; but in vegetable palæontology the imperfect knowledge of many critical characters makes it most unwise to treat fossil genera in the restricted manner in which one would proceed in dealing with existing plants. Although *Cheirostrobus* is here placed in the *Sphenophyllales*, its connection with *Sphenophyllum* does not appear to be very close.

The *Lycopodiales* occupy Lectures v–vii, and contain descriptions of *Lepidodendron*, *Lepidophloios*, *Sigillaria*, and *Stigmaria*. We cannot agree with Dr. Scott's treatment of *Halonia* and *Ulodendron*. *Halonia* is correctly referred to *Lepidophloios* as its fruiting branch (p. 156), and *Ulodendron* in part to *Lepidodendron* and *Sigillaria* (p. 152); but, again, it is said: "What, then, was the nature of the Halonial branches, which were evidently not characteristic of a separate genus, but occurred as terminal ramifications on ordinary Lepidodendroid stems?" (p. 158). Again, "Williamson, however, described a specimen with multiseriate, quincuncially arranged scars of the *Ulodendron* character, and also a *Halonia* with the tubercles in two series, so this distinction loses its value" (pp. 158–159). As references for this statement Dr. Scott mentions Williamson's figures given in Mem. xix, pl. vi, figs. 22 and 25*a*. Now the "cortex of *Lepidophloios*, with rows of Ulodendroid fructiferous scars, arranged as in *Halonia regularis*" (Williamson, l.c., p. 33), shows a typical specimen of a fruiting branch of *Lepidophloios* with leaf and cone scars, and does not possess a single Ulodendroid character; whereas Williamson's fig. 22, "a young fructiferous Halonial branch, with its tubercles in two lateral series" (l.c., p. 33), is *decorticated*, and does not exhibit any characters by which it can be referred with certainty to either *Lepidophloios*, *Lepidodendron*, or *Sigillaria*; and as *all the specimens with two rows of large scars which have shown the leaf-scars, have invariably belonged to Lepidodendron, Sigillaria, or Bothrodendron*, there seems little warrant for referring this specimen to *Lepidophloios*, especially when *no* specimen has ever been described or figured wherein a distichous arrangement of the fructiferous scars has been found associated with the *Lepidophloios* leaf-scar. We also know the specimen referred to on p. 160, and here, also, there is absolutely no evidence for including it in *Lepidophloios* rather than referring it to *Sigillaria discophora*, where the fructiferous scars were in two rows, and the other characters of this specimen would seem to refer it to this species. We would naturally expect to find that the internal organization of two such closely allied genera as *Lepidodendron* and *Lepidophloios* possessed an

almost identical structure. We believe it is now recognized that isolated vascular axes of *Sigillaria* and *Lepidodendra* cannot be distinguished apart from the structure of the cortex and its leaf cushions.

The internal structure of the Lycopodiales is admirably described. The material for the study of the *Lepidodendra*, being plentiful and exceptionally well preserved in the Yorkshire and Lancashire Coal-field and a few other localities, has given exceptional facilities for a description, which could be little more perfect had it been drawn up from the living plant. The description of the internal organization of *Sigillaria* is also good, although specimens of undoubted Sigillarian stems showing structure preserved are very rarely found. "The two lateral points on the surface of the leaf cushion below the leaf-scar" of *Lepidodendron* are supposed to have some connection with the parichnos. This conclusion may possibly be correct, but as the point is said to have been investigated by Potonié in a *Lepidophloios*, where the curious structures known as the parichnos do not occur on the cushion, it is probable that the specimen investigated was a *Lepidodendron*.

It might, perhaps, have been better if Dr. Scott had substituted the name of *Lepidodendron Veltheimianum* for that of *L. brevifolium*, given under the figure on p. 133, as the plant there shown really belongs to that species, and especially as the cones of the same stem are named *Lepidostrobus Veltheimianus* in figs. 67, 68, 69, and 70*c–d*. Professor Williamson subsequently corrected his error in identifying the Pettycur plant with Ettingshausen's *Lepidodendron brevifolium*, which latter is a *Lepidophloios* (=*Lepidophloios acerosus*, L. & H., sp.). In the same lecture *Lepidostrobus* and *Spencerites* find a place; the latter, known only from its cones with curious winged spores, is a most peculiar and interesting genus.

The Ferns occupy Lectures viii and ix, and are admirably treated. Here, we believe, is given the best and most concise account of the structure of Palæozoic ferns with which we are acquainted, for though the space devoted to their consideration is not large, their characteristics and structure are most clearly described.

Lecture viii serves somewhat as an introduction to the study of the chief fern genera and their fructifications, and concludes with a description of the anatomy of *Psaronius*. Lecture ix is reserved for the consideration of the Botryopteridæ, the two forms described being *Zygopteris Grayi* and *Botryopteris hirsuta*, which belong to the herbaceous monostelic type of fern structure. The petioles of *Z. Lacattii* and *Z. bibractensis* have long been known as common fossils in the Yorkshire and Lancashire Coal-balls. Thanks to the labours of M. Renault, in some respects *Zygopteris* is one of our most completely known fossils, but its affinities are difficult to determine, the annulate sporangia of *Zygopteris* and *Botryopteris* being very different from any fructification known to occur amongst recent ferns.

The Cycadofilices occupy Lectures x and xi, and comprise one of the most interesting groups of Palæozoic plants with which the

palæontologist has to deal. The group contains ferns belonging to several 'genera' as determined by the impressions of their fronds, for we find members of the Brongniartian genera *Sphenopteris*, *Alethopteris*, and *Neuropteris* among the Cycadofilices. *Sphenopteris Höninghausi* is the frond of *Lyginodendron Oldhamium*, and M. Renault has shown that the petioles of certain *Alethopteris* and *Neuropteris* have the structure of *Myeloxylon*, which in turn has been found attached to the stem of *Medullosa*, one of the Cycadofilices.

In dealing with these interesting plants, *Lyginodendron Oldhamium*, one of the monostelic forms, is first described. It is treated very fully, the stems, branches, roots, and foliage being very common in the 'Coal-balls.' The only point of interest unknown is its fructification, which, however, Dr. Scott presumes may have been Calymmatothecous, as shown in his restoration in the frontispiece. The evidence on which Dr. Scott arrives at this conclusion is derived from the reference to *Sphenopteris* (*Calymmatotheca*?) *Stangeri*, Stur, of a Calymmatothecous fructification, and his belief that this fern is specifically identical with *Sphenopteris Höninghausi*—a view we are unable to share, as we regard these two species as essentially distinct.

Lyginodendron—or perhaps better, *Lyginopteris Oldhamia*, as renamed by Potonié—is followed by a description of *Heterangium*, another monostelic form with Sphenopteroid foliage, at least in the case of *H. Grievi*. *Calamopitys Saturni*, whose generic name gives a very false idea of its true position, the *Cycadoxyleæ*, and *Protopityeæ*, are next considered, and these lead us up to the genus *Medullosa*, the type taken for description being the *Medullosa anglica*, Scott, the oldest known member of the genus, and one possessing a less complex structure than those occurring in later Carboniferous rocks. *Medullosa* exhibits a polystelic type of structure. All the Cycadofilices show the remarkable character of a normal development of secondary bast and xylem. The fern petioles originally named *Myeloxylon* are now known to belong to *Medullosa*. The complex organization of these ferns has been worked out in admirable detail, and the occurrence of cycadaceous characters in association with the fern type of structure is fully dwelt on.

The *Poroxylon* and *Cordaiteæ* fall to be considered in Lecture xii. The *Cordaiteæ* are only now beginning to be understood. Some species of so-called *Araucarioxylon*, which must be referred to the *Cordaiteæ*, have been shown to possess a primary wood arranged in a circle round the periphery of the pith. For our knowledge of the structure of the flowers of *Cordaites* we are indebted to M. Renault, who has worked them out in great detail. The anatomy of the leaves and roots is also known and described. The position of *Cordaites* seems to lie between Cycads and Conifers, though at the same time it holds individual characters which prevent it being united with either.

Lecture xiii gives an account of the Mesozoic Gymnosperms, and Lecture xiv is devoted to the "General Results" derived from the foregoing course of study. The last lecture is therefore in some respects the most important of all, for it gives us the conclusions

arrived at regarding the affinities of the various groups described, and contains the views of one than whom there is none more competent to express an opinion on the subject under discussion.

The results attained from the study of the Palæozoic flora lead to most interesting conclusions as to the antecedents of our existing flora, and certain points are prominently brought out. The first of these that strikes one is the entire disappearance of the traditional simple type of structure which was supposed to characterize the Carboniferous flora, the truth being that the Palæozoic plant type (at least as far back as the basement beds of the Carboniferous formation) is of a much more complex nature than is found to occur in the representatives of the similar groups at present existing; it is also further seen that it is quite possible that the recent *Equisetaceæ* are not derived from the *Calamites*, but are descendants of a simpler type which was contemporary with them, and there seems to be even less room for doubt that our *Lycopodium* and *Selaginella* have descended from a group of herbaceous Lycopods which existed side by side with the *Lepidodendra*, of which we have clear evidence as far back as the basement beds of the Carboniferous formation. The *Lepidodendra* appear to have entirely disappeared with Palæozoic times and to have transmitted no descendants to later formations.

"Studies in Fossil Botany" is one of the most valuable additions to the literature of Palæozoic botany which has appeared for many years, and shows the advance made during the last decade in the knowledge of the structure and classification of fossil plants. The student of recent botany also profits from such a volume as that issued by Dr. Scott, for it is impossible to fully understand the existing vegetation without a knowledge of the source from which it has been derived.

Dr. Scott possesses the great faculty of clear description and ability to grasp the salient structural features of the plants about which he writes, and this, coupled with his great knowledge of Palæozoic plant structures, makes his "Studies" indispensable to all students of botany; and we can only congratulate the author on the issue of a work the appearance of which has been looked for with so much interest.

The illustrations, 151 in number, are well chosen and excellent in every respect, and many of them have been specially prepared for the author. The Index, a most important adjunct, is also very complete. R. K.

II.—The Calabro-Sicilian Earthquake of November 16, 1894.

(1) G. Mercalli, "I terremoti della Calabria meridionale e del Messinese": Memorie della Soc. Ital. delle Scienze, vol. xi (1897), pp. 1–154.

(2) A. Riccò, "Riassunto della sismografia del terremoto calabro-siculo del 16 novembre, 1894": Rend. della R. Accad. dei Lincei, vol. viii (1899), pp. 3–12, 35–45.

(3) P. Tacchini, "Terremoto calabro-messinese del 16 novembre, 1894": ibid., vol. iii (1894), pp. 275–277.

(4) P. Tacchini, "Sulla registrazione a Roma del terremoto calabro-messinese del 16 novembre, 1894": ibid., vol. iii (1894), pp. 365–367.

(5) Boll. Meteor. dell' Uff. Centr. di Meteorologia e Geodinamica, Supplemento 113.

Shortly after its occurrence, a Government Commission was appointed to study the disastrous earthquake of November 16, 1894, in Sicily and Southern Italy. The work was divided into sections, the seismological part being undertaken by Prof. A. Riccò, the director of the observatory of Catania. Prof. G. Mercalli has also completed a valuable memoir on the seismic history of the district, the final chapter being devoted to the earthquake series of 1894.

Both the writers mentioned furnish maps of the isoseismal lines, Prof. Riccò making use of the Rossi-Forel scale of intensity and Prof. Mercalli of that which bears his name. In the central portion of the disturbed area, the two series of lines agree fairly closely, but they differ somewhat as regards those of lower intensity. Discrepancies in the latter are, however, to be expected on account of the small number of observations collected and the large portion of the area occupied by the sea.

The epicentral district, which overlaps that of the great Calabrian earthquake of February 5–6, 1783, lies about twenty miles north-east of Reggio Calabria. To the west and north-west, there is a notable expansion of the isoseismal lines; but in the opposite direction they are closely grouped, showing that the intensity of the shock died out rapidly in crossing the crystalline masses of Aspromonte and towards the Ionian Sea. The outermost isoseismal, according to Prof. Riccò, includes an area of 43,890 square miles.

The damage to property was confined to an area of 3,540 square miles in the provinces of Reggio Calabria and Messina; more than three-fourths occurring in the former province, where it was estimated to amount to about a million pounds. It was due chiefly to the very poor materials employed, the insufficient foundations, the imperfect connection between the different parts of the building, and the exceedingly heavy roofs. Altogether, 922 houses were completely ruined, and 44,493 more or less seriously injured; about a hundred people were killed and nearly one thousand wounded.

In nearly all parts of the disturbed area, the shock consisted of two distinct series of vibrations; the first and weaker series being separated from the other by an interval of rest lasting two or three seconds. Within and near the epicentral district, the concluding vibrations were vorticose, being subject to rapid changes of direction. Both Etna and Stromboli were strongly shaken, but neither showed any sign of increased volcanic action. A puteometer at Catania (70 miles from the epicentre) indicated an abrupt rise in the water of 17 mm., followed by a fall of 14 mm., after which it returned

nearly to its original level. The shock was also recorded by seismographs at Catania, Portici, Ischia, Rocca di Papa, Rome, Siena, Pavia, and Nicolaiew (1,009 miles from the epicentre); and the diagrams given by several of these instruments show two or more groups of oscillations.

Prof. Riccò has made some attempts to determine the depth of the seismic focus, but the results do little more than illustrate the imperfection of the methods employed. From the recorded times at Catania, Ischia, and Rome, he estimates it at 99 miles; and from the time-curve corresponding to eight good observations, at 107 miles. Mallet's method was inapplicable, and Dutton's gave values ranging from 13 to 100 miles.

Prof. Mercalli's numerous observations on the direction of the shock have an important bearing on the origin of the earthquake. He shows that there are two small areas in which the directions intersect, one on the north-west slope of Montalto d'Aspromonte, between Plati and Delianova; the other in the sea, a few miles from the coast, between Palmi and Cape Peloro. Recalling the double character of the shock, he concludes that the earthquake originated in two foci, the one beneath the sea being the last in action and giving rise to the strongest part of the shock. C. Davison.

III.—On Metamorphic Rocks in Eastern Tyrone and Southern Donegal. By G. A. J. Cole. Trans. Roy. Irish Acad., 1900, vol. xxxi, pp. 431–472.

On certain Rocks styled 'Felstones' occurring as Dykes in the County of Donegal. By G. A. J. Cole and J. A. Cunningham. Scientific Proc. Roy. Dublin Soc., 1900, vol. ix (n.s.), pp. 314–324.

THE problems presented for investigation in the complex regions of crystalline rocks near Pomeroy in Tyrone, and Pettigo in Donegal, are stated, in the first paper, as a series of questions—

(i) Is the intrusive granite distinct from the gneiss, or is the former merely an offshoot from the latter?

(ii) Is the gneiss itself an igneous rock, and if so, has it assumed its local richness in ferromagnesian minerals by absorption of basic and other rocks adjoining it?

(iii) If the gneiss is distinct from and older than the granite, what claim has it to be regarded as Archæan and fundamental?

The author favours the view that the gneiss has been produced by the intricate intrusion of a granitic magma into ancient schists, which may originally have been of sedimentary origin. The gneisses thus produced, as well as the less altered schists, are traversed by and included in the granite of the Slieve Gallion type, which also cuts an overlying basic igneous series, the latter giving rise to 'eyes' of amphibolite. The paper is illustrated by two plates, one of them coloured.

Three series of igneous dykes occur in the schists and quartzites of the north-west of Ireland; those belonging to the series intermediate in age are described in the Survey publications as 'felstones,' but they have since been shown by Hyland and others to include various rocks of the lamprophyre group (camptonite, vogesite, minette, kersantite). In the second paper quoted above these determinations are confirmed, and a glassy olivine-basalt belonging to the same series is also described.

IV.—Some Recent Papers by Professor W. M. Davis.

WHEN ascending the valley of the Ticino on the way to St. Gothard, Professor W. M. Davis observed that the side valleys opened into the main valley several hundred feet up, and streams cascaded down in sharp-cut shallow clefts. Such discordance between main and lateral valleys appears to be the rule in Alpine regions, and in all valleys which have been strongly glaciated; and the attention which Professor Davis has given to the subject dispelled the doubts which he had long felt as to the ability of ice to erode deep valleys and basins. It is not surprising to learn that the features are, in his opinion, of so much importance that a special name, that of 'hanging valleys,' suggested by Professor Gilbert, is employed to designate these side valleys. The peculiar features to which he draws attention are ascribed to the action of the heavy ice-stream that once filled the valley to a great depth: this trunk glacier at times rose so high that the small lateral glaciers were held back and prevented from deepening their channels, while the main valley was continuously subject to erosion. ("Appalachia," vol. ix, March, 1900.)

The recognition of the competence of glaciers thus to deepen and widen their valleys is regarded by Professor Davis as an important supplement to the belief that they can excavate lake basins. He therefore pursues the subject of "overdeepened main valleys and hanging lateral valleys," in an article on Glacial Erosion in France, Switzerland, and Norway (Proc. Boston Soc. Nat. Hist., vol. xxix, July, 1900). He points out that if the existing breadth of the glaciated valleys, which are broad-floored, had been acquired in the ordinary manner by the lateral swinging of the main stream and by the weathering of the walls, the long time required for such a change would have amply sufficed for the side streams to cut down their valleys to grade with the main valley. He concludes that the troughs were deepened and widened by ice-action. Similar features occur on the borders of Lake Lugano and other Alpine lakes, in our own Lake District, and in Norway. Irregularities along the main valleys eroded by glaciers may have arisen through the greater destruction of softer or more jointed rocks; and if the glacier should vanish by climatic change while in this condition a lake would occupy the deepened reach, and its outlet would flow forward over rocky ledges to the next lower reach or lake. As the energy

of a glacier is declining, it becomes in its lower course only a transporting, not an eroding agent, and this would facilitate for a time irregular erosion. Professor Davis discusses the origin of Corrie Basins, and concludes with a review of previous writings on the subject of glacial erosion. This and the previously mentioned paper are illustrated by excellent photographic plates.

Professor Davis gives a graphic account of a fault scarp in the Lepini Mountains of Italy (Bull. Geol. Soc. Amer., vol. xi, April, 1900). The region, as described by Signor Viola, consists of Cretaceous limestone, capped here and there with Eocene beds, uplifted and separated from the Eocene of the Sacco Valley by a fault of considerable magnitude. Extinct Quaternary volcanoes occur on the southern part of the fault line. The fault scarp may be seen from Morolo station to occur along the mountain base. If the original uplift of the mountain mass ever produced a great fault cliff all traces of it are now destroyed, for the front is carved into a succession of buttressing-spurs and ravines. 'Rock-fans' or débris due to the retrogression of the escarpment are described. The fault scarp, in Professor Davis' opinion, is much more recent than the great dislocation which upraised the mass of the mountain front, and was probably due rather to an irregular depression of the Piedmont Eocene mass than to a further elevation of the Cretaceous mountain block.

In an article on the Fresh-water Tertiary Formations of the Rocky Mountain Region (Proc. Amer. Acad., vol. xxxv, March, 1900), Professor Davis maintains that sufficient attention has not been given to the fact that rivers deposit as well as erode, and that in consequence the probable fluviatile origin of most Piedmont plains has not been generally realized. He gives reasons for believing that mere continuity of even-bedded deposits, such as occur in the Tertiary formations of Western America, even if occupying many square miles, should not alone be taken as conclusive evidence of lacustrine origin. The object of his paper is to promote consideration of the subject.

CORRESPONDENCE.

A FELSTONE DYKE ON LLECHOG.

Sir,—In my paper published in the Geological Magazine under the title "Firstfruits of a Geological Examination of Snowdon,"[1] I said that the Felstone Dyke on Llechog might possibly be the same as are seen in Cwm Clogwyn at the foot of Llechog. I have now satisfied myself that such is the case, and I give a diagram (not drawn to scale) showing how the dyke rises through the cleaved felsitic rocks of the mountain, and a sketch-map of the area where it occurs. The dyke is from 15 to 20 yards wide where

[1] Geol. Mag., 1900, June, p. 267.

the section is drawn, but on the top of the cliff it rapidly thins away towards the south-east. In the cwm below it can be traced for about two hundred yards till it is lost to sight under débris.

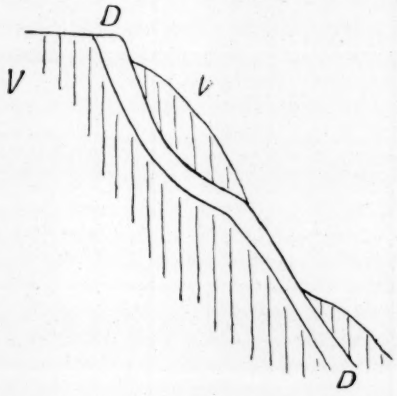
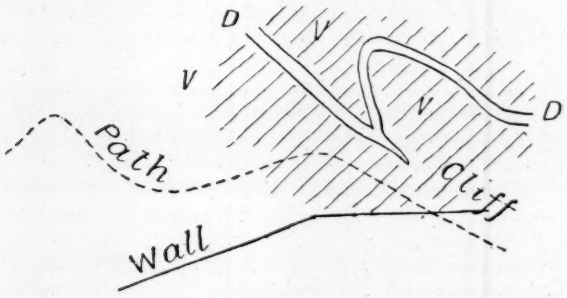


DIAGRAM.
D, dyke; V, cleaved volcanic rocks.



SKETCH-MAP.
D, dyke; V ////, cleaved volcanic rocks. Strike of cleavage, N.E.

This arm of Snowdon called Llechog must not be confused with that overlooking the Pass of Llanberis. The word Llechog means a 'slaty place,' and is applied to more than one such place.

J. R. DAKYNS.

RHYD-DDU, CARNARVON.

MISCELLANEOUS.

VICTORIA INSTITUTE.—At a special general meeting of the Victoria Institute held at Adelphi Terrace on Monday, 5th November, Sir G. Gabriel Stokes, President, in the chair, Professor Edward Hull, F.R.S., was unanimously elected Secretary to the Institute, in the room of the late Captain Francis Petrie.

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COLOURED CASTS OF RARE FOSSILS

SUPPLIED BY

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96. **Tetraconodon magnum**, Falconer. Pliocene: Siwalik Hills, India. Portion of mandible. Figured by R. Lydekker, Esq., F.G.S., etc., in "Palæontologia Indica," ser. x, vol. i, pt. 2, pl. x. This genus, allied to *Elotherium*, is remarkable for the great size of the premolars relatively to the true molars. Length 20 cm.

97. **Tritylodon longævus**, Owen. Skull. Figured in Quart. Journ. Geol. Soc., vol. xl, pl. vi, figs. 1–7. Triassic (?): South Africa.

98. **Trirachodon Kannemeyeri**, Seeley. Skull and mandible. Described and figured in Phil. Trans., vol. 186B (1895), p. 48, pl. ii, figs. 1–4. Karoo Formation: Burghersdorp, Cape Colony. Albany Museum.

99. **Rhytina gigas**, Linn. Cranium and lower jaw. Size 68 cm. Behring's Island. Original in the British Museum (Natural History). This interesting specimen, forming part of a nearly perfect skeleton, was described in the Quart. Journ. Geol. Soc., vol. xli (1885), pp. 457–472, by Henry Woodward, LL.D., F.R.S., F.G.S., etc.

The following parts of the skeleton of RHYTINA have also been reproduced:—

100.	Cast of brain-cavity	1
101.	Set of auditory ossicles	3
102.	Atlas and axis and five other cervical vertebræ...	7
103.	Dorsal vertebra with transverse processes ...	1
104.	Lumbar do.	1
105.	Caudal do.	3
106.	Scapula	1
107.	Radius and ulna conjoined	1
108.	Humerus	1

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Figured and described by E. T. Newton, Esq., F.R.S., in Phil. Trans. Roy. Soc. London, 1893.

109. **Elginia mirabilis.** Cranium.
110. **Geikia Elginensis.** Cranium.
111. ——— ——— Mandible.
112. **Gordonia Huxleyana.** Left side of cranium, with part of mandible.
113. ——— ——— Scapula, humerus, and clavicle.
114. **Gordonia Juddiana.** Left side of cranium.
115. **Gordonia Traquairi.** Left side of cranium, with part of mandible (*a*).
116. ——— ——— ,, ,, (*b*).
117. ——— ——— Scapula, humerus, ulna, and radius.
118. **Sacrum, etc.** (Genus undetermined.)
119. **Herpetosuchus Granti.** Cranium and ramus of mandible (1894).

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